A Detailed Conservation Report of a Heavily Retouched Painting from the Otto Valstad Collection

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Abstract:

This master thesis is a remedial conservation report of the painting *Maria og Elisabeth med barna i et landskap*, with its English title translated by the author to: *Virgin and child with St Elizabeth and infant St John the Baptist, in a landscape* from the Asker Museum collection. It combines all of the necessities of a conservation report by describing the paintings condition, and identifying its original and secondary materials prior to its 2013/2014 conservation treatment. It also includes information regarding further preservation actions that can be done to improve its longevity in its current environment.

Investigations undertaken on the painting were both non-invasive and invasive. They combined visual investigations, photo-analytical methods of analysis and XRF investigations, together with optical microscopy examinations and SEM-EDX analysis. For the 2013/2014 treatment, its structural requirements were far more addressed than its visual integration and cleaning treatment needs, as they were considered far more subjective. It has gone through a delining, including a removal of its previous mounting and its previous stretcher was switched out. A strip-lining has taken its place by giving the painting the support its required along the edges and so it could be properly stretched to a new auxillary support in a traditional manner. Only a selective cleaning took place by removing varnish layers on all of the figures and a large overpainting found in the sky of the motif. Visual reintegration also included an attachment of a paspatout on the paintings lower and upper halves to lessen personal opinion onto such large regions of bare secondary canvas. Preventive measures such as the addition of a backing board and four corks were supplemented in order to aid in the painting's longevity. These were added to the painting in hopes of providing better support during handling and reducing the likelihood of condensation of forming on its backside as it is hung on an outer wall.

Ethical considerations and deliberations were implemented with regards to all investigations and when concerned with 2013/2014 treatment options. Correspondingly, justification has been stated whenever original samples were extracted. It was treated with regards on being displayed in a historic house, implementing the importance of its 'last used phase' into the 2013/2014 treatment while simultaneously accessing the possibility of representing a copy of a lost artwork by Raphael Sanzio. Discussion with the museum was a main concern to ensure that conservation work applied to the paintings was not proceeded upon without the Museums own personal opinions, seeing that they understand Otto Valstad the best. Overall, its 2013/2014 treatment was proceeded upon so that it still has the possibility of being further studied with regards to its secondary materials. The investigations and treatment were properly documented and their still remains a substantial amount of secondary material that may or may not have been added by Otto Valstads himself.

Preface

As this is a master thesis in painting conservation, I would first like to thank my supervisor, professor Tine Frøysaker, for all her support through this tough semester. Her help and guidance regarding both my theoretical and practical work were greatly appreciated.

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Emma Johansson,

January 2014

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1 Introduction

The subject of this master's thesis is a remedial conservation report of the painting *Maria og Elisabeth med barna i et landskap,* with its English title translated by the author to: *Virgin and child with St Elizabeth and infant St John the Baptist, in a landscape* (Appendix 1 Fig1.1). As further mentioned in the chapter 3, this painting is part of the Asker Museum collection, a historic house just outside the city of Oslo, Norway. Since this thesis included practical conservation work, its central focus will be on the investigations and corresponding 2013/2014 treatment of the painting. Considering that the painting has been treated previously, both structurally and through the identification of additional secondary paint, this aspects will also be emphasized. The thesis will follow a standard structure laid forth by the conservation programme at the University of Oslo consisting of chapters related to each aspect of a typical conservation report. A conservation report is a requirement for the undertaking of any conservation action on cultural heritage (AIC 2994; ECCO 2002). It often embodies investigations into the painting's context and history, original materials, earlier treatment, and condition prior to proceeding with any necessary treatment. A description and understanding should also be made clear regarding all of the methods of analysis performed during the investigation and treatment processes. In addition, a coherent explanation of any necessary treatment embarked upon after the investigation must be thoroughly defined (AIC 1994; ECCO 2002). Likewise, preventive conservation is also an imperative component of a conservator's duty to communicate proper practices that should be considered in the further preservation of a cultural object, especially after a painting has been remedially treated (AIC 1994; ECCO 2002).As a result of such requirements, this thesis will follow all aspects mentioned above, by representing each section of a typical conservation report into its own chapter. This will make it clear and concise what every chapter will focus on. Consequently, Chapter 2 will present the different methods of analysis employed during the investigation and treatment of the painting. Chapter 3 provides a historical background for the provenience and main stylistic attributes of the painting, whereas Chapter 4, 5 and 6 address its original materials, earlier treatment and condition, respectively. Chapter 7 present the treatment performed on the painting based on the investigations, and Chapter 8 provdies suggested preventive conservation measures to further preserve the painting in its current environment. Chapter 9 presents concluding remarks.

Introduction

Virgin and child with St Elizabeth and infant St John the Baptist, in a landscape – Asker Museum

2 Methods of Analysis

This chapter will focus on all of the non-invasive and invasive investigations performed on each original and secondary part of this painting. The chapter is divided into all the separate parts of the painting, with subheadings relating to investigations performed regarding material identification purposes and those related directly to condition assessment.

The examination process for the painting was primarily investigated using non-invasive methods of analysis either performed by the naked eye or through photo-analytical investigations. The photo-analytical investigations performed on this painting are ultraviolet illumination (UV), Infrared-1 and Infraed-2 imaging (IR), False colour infrared-1 and false colour infrared-2 imaging (FCIR), and x-ray. To render this text more easily understood, explanations and corresponding images of each of these photo-analytical method can be found in Appendix 1; thereby omitting there description from this text. Similarly, when 'visual investigations' are stated to have been performed on the painting, it should be understood that this refers to examinations performed using the naked eye and/or under magnification (either by the use of Dino-lite (50x-200x) and/or by the use of the stereomicroscope (6.3x-40x)). Also, a clarification of how both energy X-ray flouresence (XRF) and scanning electron microscopy (SEM-EDX) can be found together with their analysis in Appendix 2 and Appendix 3. Therefore, when these methods of analysis are mentioned in this text, it is implied and emphasized here, that the reader has read and understood these methods of analysis described in these appendix documents.

The majority of information can be obtained by non-invasive methods of analysis. Therefore, although it may not be clear in the text, every examination started with visual investigations prior to proceeding to more invasive methods of analysis. This is performed as in this initial stage basic insight is generally provided to further guide along any assessment of the painting's original materials, secondary materials or condition (Taft and Mayer 2000:9; Stuart 2007:43). Therefore, most parts of the painting only required visual investigations, due to a deliberate choice of upholding ethical guidelines regarding the removal of original material (AIC 1994; ECCO 2012). Yet, in some cases when sufficient information was not obtainable through non-invasive analysis, micro-samples were taken. However, a justification is presented in the text when samples, such as these, were taken.

Secondary decorative frame

Identification

Once the decorative frame was identified as being secondary due to stylistic comparative analysis, the actual material identification that made up the decorative frame were not prioritized and not further investigated (Img 1-6). Therefore, the examination methods that identified the decorative frame as secondary were visual investigations and through comparative studies. The comparative analysis was took place with a decorative frame found in the cafeteria at Asker Museum. The painting[1] found in the Asker Museum cafeteria's has a decorative frame, of the exact same style and size as this one, indicating that this decorative frame is not likely original. Intrusive methods of analysis were therefore not proceeded upon since this conservation report was heavily centered on the painting itself.

Condition

With regards to its condition only visual investigations were undertaken. No additional analysis was deemed necessary as its condition was considered stable.

Secondary stretcher

(Img 5-10)

Identification

The identification of the wood that this secondary auxiliary support was made of was through visual investigations and comparisons of known tree sorts found in corresponding literature.Upon discovery that the auxiliary support was secondary, was in fairly bad condition, and made of a coniferous tree sort, no further intrusive methods of analysis were required to further investigate the specific type of tree sort.

Condition

The stretcher was examined visually in order to assess its condition. No additional analysis was deemed necessary, as visual investigation proved to be sufficient in deliberating on its current state.

Original and secondary canvas

Identification

The identification of the original and secondary canvases were explored with regards to their material identification through 1) visual investigations, 2) cross-examinations of extracted threads by use of optical microscopy in both longitudinal and cross- sections, 3) the performance of a twist test and 4) a thread

[1] Otto Valstad (1862-1950), *Ottos far polerer spisestue stolene*.

count. These results, including the extraction sites for the four canvas threads[2] can be found in Appendix 4.

Condition

The accurate identification of the secondary and original canvases were significant in their condition assessment due to the previous lining. Therefore, the reason for the extraction of the two original and two secondary canvas threads were justified since identification was crucial in the understanding of their impact on one another with respects to the condition of the previous lining. This is because, if the two canvases were made of different materials, their hygroscopic reactions would vary (Reifsnyder 2012:423) which would reflect the state of the previous lining treatment. Affirmation of a materials identity would also be beneficial when deliberating on the choice of materials to be used for the 2013/2014 treatment.

The performance of pH testing and a thread folding test also proved vital understanding in the level of deterioration and elasticity that the two canvases retained. The same extracted samples used for identification through optical microscopy were also used in the performance of the thread folding test to ensure minimal extraction of any material.

Thread folding tests aid in a conservators understanding of the threads elasticity and brittleness, placing them in a grading system based on their stretching capabilities (Oriola et al 2011:5). Its execution was performed according to Oriola et al (2011), where each extracted thread was folded 10 times back and forth in the exact same area. If the thread broke prior to the 10 folds it was given a category 1, 2 or 3; while if it did not break after 10 folds it received a category of 4. A category of 4 meant the thread had good stretching capabilities while a category of 1 meant that it did not. In Appendix 4, the results of the thread folding tests are also given for each thread.

pH strip testing was performed on the two canvases since low pH leads to accelerated deterioration of cellulose based materials (Strlič et al 2004:35). Its execution was performed in the manner described by Tse (2007:10), where one droplet of pH neutral water was placed on the canvas' backside and the pH strip was placed thereafter for 60 seconds. The colour of the pH strip was thereafter immediately recorded and analyzed. A pH strip test was performed on both the two canvases while they were previously lined, and also during the 2013/2014 treatment when the lining was removed and thereafter cleaned. The results of the pH test can be found in Appendix 5. pH strips were used rather than pH measurements

[2] Two secondary (horizontal and vertical) and two original (horizontal and vertical)

performed with a pH decive, since this required large extracted material. And as the painting possessed no tacking margins all original canvas material would have contained either original or secondary paint; thereby considered unjustifiable regarding an ethical method of analysis (AIC1994; ECCO 2002). The secondary canvas could have been considered being calculated using the pH measuring device, however, comparisons pH results would have been limiting (Tse 2007:6-7). Therefore, it was disregarded.

Both the original and secondary canvases' condition were also investigated by transillumination and raking light. Transillumination and raking light are considered two ways of examining a painting using different types of light. Transillumination (Imgs 23 & 24) involves the light being placed behind the painting where the light will shine easily through weakened canvas areas or where paint loss is apparent. Raking light (Img 25) involves the light being omitted from the side of the painting rendering deformations in the canvas more easily assessable. The later method especially was significant in analyzing the condition of the previous lining (Imgs 25 & 26).

Glue, used to attach the stretcher to the painting (Stretcher glue)

Identification

The stretcher glue was visually investigated in both visible and UV light. Under UV, in particular it had a strong white flourescence which differentiating it between the glue used in the lining (Appendix 6 Fig 6.1-6.3). A water solubility test was performed first on the glue, identifying it as water soluble. And based on its solubility, an additional protein test was performed on the glue, since animal glues are considered to be soluble in water (Reifsynder 2012:416). The water solubility test involved the use of a small cotton swab rubbed over between the canvas and stretcher ledge to see if the canvas would detach. Suggested by Odegaard (et al 2005:144-145), the protein test involved the extraction of a small piece of the glue suspended in a solution where it would turn purple if it contained protein (Appendix 6 Fig 6.4). Other tests were disregarded after these two intrusive tests were performed since they proved successful in their identification.

Fourier transform infrared microscopy (FTIR), in this case, was performed on this sample as a form of a control test. The FTIR graph for this sample can be found in Appendix 6 Fig 6.5. An FTIR spectrum is obtained by letting infrared radiation pass through a sample. The sample is placed just below the ATR sampling accessory and the majority of functional groups that make up the sample are then represented by absorption peaks illustrated on a spectrum (Stuart 2007:110). If not already known, a conservator can identify the sample by examining the different types and levels of absorption peaks on the given FTIR

spectrum and compare them with known samples from a database. Therefore, FTIR is a method of analysis that is usually performed relatively late in the investigation process since it requires extracted material, but also as much knowledge regarding the sample should be known as interpretation of the results will be required.

Condition

The identification of the stretcher glue was significant as its classification would have an impact on how the 2013/2014 structural treatment would be performed. Seeing that this sort of attachment of the canvase to the stretcher was an uncustomary way of mounting a canvas to its auxiliary support, it was important to identify what type of glue this was made of as this could help describe damages found throughout the painting. As the investigations pointed to an animal glue, a glue that is considered hygroscopic (Mecklenburg 2005), it was understood that this adhesive had most likely passed into the matrix of the painting (Reifsynder 2012:421). And, during its drying process, the stretcher glue had likely contracted, often resulting in tenting and cupping of original paint layers (Reifsynder 2012:421). However, due to the fact that this glue was not used in the lining but rather only in the mounting of the canvas, its presence was an explanation that likely pointed to the drastic amount of loss found along the right edge of the painting.

Glue, used in the lining (Lining glue)

Identification

The lining glue was investigated visually in both visible and UV light (Appendix 7 Fig 7.1-7.2). Just like in the case of the stretcher glue, a solubility test for water was also performed. In addition, as the lining glue indicated solubility with water, the same test for proteins executed on the stretcher glue was also performed on an extracted sample of the lining glue. However, this test yielded unfavorable results. Thus, a supplementary test for starch was completed on another extracted sample of the lining glue. A test for cereal-based glue was warranted as these glues were often typical for linings, and are also considered to be soluble in water (Reifsnyder 2012:416). Suggested by Odegaard (et al 2005:128-129), this test involved suspending a sample in a solution where its residue would omit a violet hue. Simultaneously, a control test was executed using the same solution on a known cereal based sample[3] to ensure that the test gave accurate results (Appendix 7 Fig 7.3-7.5). No additional tests like FTIR were needed as these two tests proved to identify the lining glue as cereal-based.

[3] Oatmeal

Condition

Just like the stretcher glue, the identification of the lining glue was important to confirm as its components could be studied with regards to condition of the original paint layers and canvas. Also, its identification advocated for the removal of the lining in the 2013/2014 treatment. A pH strip test was also performed on the cereal-based glue to test its acidity level (Appendix 5). This type of testing was performed since the presence of high acidity levels in a canvas will encourage degradation (Tse 2007:1) and since the majority of liquid glue-paste formulations can pass through the lining canvas from the back and saturate the original canvas (Refsnyder 2012:421), it was clear that its pH level would impact the acid levels of the original canvas. As noted in in Appendix 5, the lining glue appeared to be far more acidic then when compared with the acidity level of the cleaned original canvas; therefore, this type of testing was also essential in justifying the glue lining's impact on the paintings condition.

Glue sizing, ground and original paint layers

Identification of original materials[4]

Both the ground and the original paint layers were investigated through non-invasive methods of analysis, including visual investigations, XRF (Appendix 2), and through comparisons using the x-radiograph and FCIR images (Appendix 1 Fig 1.2, 1.7-1.8). Yet, the glue sizing was merely investigated visually.

Two samples were extracted from the painting, consisting of the ground and original paint layers. These two samples (CS-1 blue and CS-2 yellow) were examined using optical microscopy and SEM-EDX. Their extraction was advocated for, as they would help to identify original materials but also prove valuable in understanding the painting's application technique. Their extraction sites and results of examination can be found in Appendix 3.

Colour stratigraphy chart

All of the information regarding how the different original paint layers were applied in this painting were organized into one unified chart. This chart is known as a *Colour Stratigraphy Chart* and can be found in Appendix 8. This was produced in order to help visually map the paintings original application technique by simplifying all information regarding each original paint layer located on the painting into a systematized chart. This chart is a modified rendition of Unn Plahters (1987:46) colour stratigraphy chart, proposed for medieval paintings and provides an overview of all of the investigations performed

[4] Ground and original paint layers

on the original paint layers. Therefore, since this chart is used to organize all the results retrieved from all investigation methods, it is intended to function as a platform where a more visual representation and interpretation of the original painting technique can be carried out.

Condition of original materials

The condition assessment of the glue sizing, ground and original paint layers were investigated together as their condition can be considered directly related to one another. This was considered since paint loss can be described through the lifting, flaking, tenting and cupping of the original paint layers either between the ground, or between the ground[5] and the glue sizing (von der Goltz et al 2012b:369). Visual investigations, and the use of raking light (Img 25) were the best source for identifying any delamination. However, methods such as transillumination (Imgs 24 & 26), IR, and x-ray (Appendix 1 Fig 1.2, 1.5-1.6) were also used for localization purposes of any delamination or loss found throughout the painting. It should be noted, however, that although the painting had suffered severe paint loss in its past, it was not currently suffering from delamination at this current time. Therefore, no additional methods of investigation were needed apart from those mentioned here.

Filler material and secondary paint

Identification, secondary materials

Due to the large amount of secondary paint and filler material found on this painting, there exact identification was not prioritized. Only visual examinations as well as a selective few XRFs (Appendix 2) were able to help identify some of their material components. However, through their removal during the 2013/2014 cleaning treatment process, it was clear that the filler material was soluble in water and the majority of the secondary paint were soluble with isopropanol.

The localization of secondary paint[6] and filler material were registered (Imgs 27-35). They were best observed using comparative investigations of visual analysis together with photo-analytical methods such as x-ray, UV, and IR (Appendix 1 Fig 1.2-1.6). Their localization was important to establish prior to cleaning in order to ensure that cleaning in the 2013/2014 treatment would be proceeded upon ethically and their removal heavily considered. X-ray especially (Appendix 1 Fig 1.2), as well as removability tests, made it possible to observe a large overpainting found throughout the entire sky in the motif. X-ray provided significant information regarding the existence of intact original paint observed beneath

[5] Including subsequent original paint layers
[6] Both in-painting and overpaint

this overpainting. In addition, one of the two extracted samples (CS-1 blue) was also extracted specifically from this overpainted area in order to gain in the further understanding of the secondary paint found in this painting. Therefore, this sample (CS-1 blue) found in Appendix 3, contained both original and secondary material, and was studied using optical microscopy and SEM-EDX. This extraction sight was ideal and also justified since; both secondary paint as well as original paint could be analyzed simultaneously in one single sample.

Condition of secondary materials

The condition of the secondary paint and filler material were mainly based on visual investigations, as well as concerns based on their removability and personal judgement regarding visual aesthetics.

Secondary varnish layers

Identification

For identification purposes, the varnish layers were visually investigated under visible light, UV and through cleaning tests (Appendix 1 Fig 1.3-1.4). UV helped identify the type of varnish used as different types of varnishes, synthetic and organic, fluoresces differently in UV. The varnish layers were also studied under optical microscopy while using UV in the two extracted samples taken of the paint layers (Appendix 3). However, while examining the SEM-EDX results of the varnish layers, no identifying elements apart from oxygen and carbon, were available.

Condition

The condition of the varnish was best observed by the naked eye in visible light and under UV (Appendix 1 Fig 1.3-1.4). This is because the varnish layer becomes darker, more yellow, and more obscure within a few decades of application (Phenix and Wolbers 2012:524). This yellowing of the varnish in visible light was best observed in areas of the original paint layers that were recognized as white (Img 20). UV was helpful in understanding the deterioration of the varnish layers since, as the varnish ages it appears more opaque (de la Rie 1982:2). This is important to know since, varnishes that are more aged can at times be more difficult to remove (Phenix and Wolbers 2012:530-531) as they require more porlar solvents. Therefore, removal testing was also a method executed of assessing its condition.

Secondary surface dirt

Identification

The surface dirt of this painting was not examined with regards to its exact components. It was only merely observed to the point of confirming its existence, through visual investigations and cleaning tests. Its components were estimated through personal communication with Asker Museum, with regards to known activities that existed throughout the room where the painting is currently displayed. A wax substance was visually observed on the painting, yet due to time restraints this material was not further investigated upon as it was most likely from a candle that at one point in time had dripped on the painting (Img 19).

Condition

In order to understand the extent of the surface dirt, a cotton swab was used together with saliva over the surface of the painting. The extent of the surface dirt was important to comprehend as surface dirt, especially in large quantities, can be quite detrimental to a paintings condition (van Loon et al 2012:234-236).

Reconstruction

Tests were also conducted with regards to understanding different lining materials based on literary research. These included tests on different adhesives, textile materials and application techniques (Imgs 21-22). The adhesives tested were Lascaux 498, Lascaux 368 HV, Lascaux 375[7] and Beva 371 film. And the different textile materials were the used were in hopes of understanding the effects of using an interleaf of both Melinex and Hollytex in different combinations between different thicknesses of Polyester Sailcloth. The application techniques tested were by the use of spray, brush and the attemp of producing nap-binding through the use of a rolling pin. All tests were executed on the Hot suction table. Still, Beva 371 film proved to be the least messy of all the adhesives, with regards to its application

[7] Lascaux 375 is the most likely the Lascaux adhesive described by Berger that took on the name Beva (Berger 1995:26) due to its main components. Beva 371 solution is made of ethylene vinyl acetate copolymer, Cyclohexanone resin, Ethylene vinyl acetate copolymer, Phthalate ester of hydroabietyl alcohol, and Petrolatum (Paraffin). While Lascaux 375 is made of a base of ethylene vinyl acetate copolymer, cyclohexanone resin, phthalate esters of hydroabiethyl alcohol and paraffin.

Virgin and child with St Elizabeth and infant St John the Baptist, in a landscape – Asker Museum

3 Historical Context

Since remedial conservation consists of direct action carried out on damaged or deteriorated cultural heritage while simultaneously respecting its historic properties (ECCO 2002), this conservation report will also provide all historical investigations performed on the painting with regard to its provenience, motif, and stylistic attributes. This included research into the Asker Museum registrar, and Otto Valstad's gjendstadsprotocol, its exhibition catalogues, as well as biblical and art historical investigations. This type of understanding was significant so that 2013/2014 treatment performed on the painting would be ethical considered, as a full understanding of the painting, and not only with regards to its condition, original and second materials would provide insight into how the 2013/2014 treatment would be undertaken.

Provenience

The painting belongs to Asker Museum, a historic house, once owned by Otto Valstad, located just outside of Oslo. To date, little documentation exists concerning this painting. No signature, date or artist have been recorded in the museum's files (Otto Valstads gjendstandsprotocol). The only information of the painting in the museum registrar is a description as well as an indefinite historical account that it may have been purchased in Italy. This latter claim may be supported by the fact that Otto and his wife Tilla travelled to Italy at the start of the twentieth century, visiting Florence, Rome and Venice (Foss 1999:16, 30; Espinoza 2006: 11,12). Also, a great interest among Norwegian artists existed at this time regarding Italian art, in particular the time of Bottecelli (Wolloch, cited in Espinoza 2006:12). Therefore, this interest combined with the subsequent discussion in section 3.2 regarding the motif and stylistic characteristics of the painting, may further support this claim. These disions may further indicate that the painting was in fact not only purchased, but also created, in Italy.

Key attributes

Apart from material identification, such as the use of the pigment lead-tin yellow[8] and the use of artist materials oil on canvas, there are a few other key aspects in the design that are of importance with regards to placing it in an art historical stylistic timeframe. These are: the motif itself, the nudity found in the painting, the anatomy of the figures, a single sketch illustrating comparable poses, and stylistic characteristics that place it into a particular time period.

[8] This could also be lead-tin-antinomy yellow or lead antinomate yellow.

Motif

The people that are observed in this painting are the Virgin Mary, her child Jesus, St. Elizabeth and her son St. John the Baptist (Appendix 1 Fig 1.1). St. Mary is seated to the right, in a slightly higher position to the kneeling St. Elizabeth to the left. The two children are depicted in the nude, in front of their respected mothers, with Jesus leaning on his mother between her knees, while St. John is slightly resting against his mother. The two females are both delicately holding their children while St. John is softly grasping Jesus' right arm. A crib stands to the left of Jesus with St. John the Baptist's reed cross leaning against it. A tree is depicted behind St. Mary on the right hand side of the painting, and a fairly flat mountainous landscape is depicted in the entire background. Between the two women, the new Jerusalem can be observed in the far distance.

Although this scene was often painted in the Italian Renaissance (Imgs 37-39), it is not specifically described in the bible. The only time that St. Mary and St. Elizabeth met is in the *Visitation* from the Gospel of Luke.[9] Yet, the *Visitation* is only a meeting between St. Mary and St. Elizabeth while the two women were pregnant. Nevertheless, this iconographic and non-biblical scene has been artistically portrayed numerous times during the High Renaissance by Raphael and his contemporaries.

The sketch

A sketch by Raphael Sanzio (1483-1520) has been identified depicting all of the same figures in this painting in identical poses (Img 36), and was completed around 1506 in Florence (Royal Collection Trust 2013). According to Bambach (2002b), by the fourteenth century, artists began to explore ideas and designs of their final paintings through the use of drawings. Likewise, at this time, painters only worked on commission (Hartt and Wilkins 2003:44) and were required through contracts to illustrate to potential patrons their final design (Bamback 2002b). Based on this information, a painting of this exact composition *may possibly* have been executed by Raphael in 1506. Nevertheless, no painting illustrated exactly in this manner has been linked to any surviving Raphael paintings, since the Royal Collection Trust (2013), refer to the *Carnigiani Holy Family*[10] (Img 37) as the painting corresponding to this sketch. Therefore, this thesis painting could ultimately indicate that Raphael's 'real' painting linked to this sketch has been lost or that the *Virgin and Child with St Elizabeth and infant St John* was painted

[9] Out of all the gospels, Luke is the only one who describes John the Baptist's mother and father, and state that the two mothers are cousins. The other gospels state no such claim and elude that Jesus and St John met in adulthood.
[10] found in the Alte Pinakothek, Munich, Germany

with only Raphael's sketch in mind. Either way, this is unknown and the only information retained here is that this thesis painting was likely produced after the production of the sketch in ca. 1506.

Nudity

The fact that both Jesus and St. John are represented as nudes, also indicate a certain restriction regarding its creation. It was not until the Renaissance and the rediscovery of antiquity that the nude was represented in art (Sorbella 2008). The earliest of the nude figures appear in Italy in the mid-thirteenth century, such as Donatello's David from ca. 1440. And, by the mid-fifteenth century, nudes were deemed normal in works of art, especially in religious paintings (Sorbella 2008). The Christ child (Img 18), in particular, was extensively portrayed nude with his ''sex prominently exposed'' in order to clarify his status as God made into man (Sorbella 2008). Thus, as nudes, point to a specific time period for the painting there is a high probability that it was created after the mid-fifteenth century.

Anatomy

Looking at the anatomy of the two nude figures in a painting, can also help place it in an art historical timeframe. With the rediscovery in the Renaissance of antiquity, a more sculpturally represented human form arose, prompted by the interest of the human body through nude modeling and anatomical dissections (Bambach 2002a). Pollaiuolo (1431/32–1498), Michelangelo (1475–1564) and da Vinci (1452–1519) were the first of the artists to investigate musculature by dissection, and it is through their works of art that new standards regarding the portrayal of the human form were produced in paintings (Bambach 2002a). Furthermore, it was around this time that Italian patrons expected anatomical accuracy in their commissions with the rendition of St. Johns bent knee serving as a good example of this artists' increasing anatomical understanding of the human body (Img 17). Consequently, it can be assumed that this painting was created during or following this peak of interest, at the beginning of the sixteenth century.

Materials used

The painting has also been established of being painted using oil on a canvas[11]. These were general materials used in Italy no earliar then the fifteenth century (Kleiner and Mamiya 2005:639; Hartt and Wil-

[11] See Original Materials Chapter 4

kins 2003:303,447 and 502). Other aspects, such as the identification of lead-tin yellow[12] found in this painting, can also help support the paintings art historical timeframe.

Conclusion

Therefore, in combination with the materials used in this painting as well as the key stylistic attributes mentioned above, the paintings date of creation can presumably have been either in the High Renaissance (1490-1530) or in the Mannerism movement (1520-1600). Simultaneously, Raphael was considered an artist of the High Renaissance and an inspiration for Mannerists (Hartt and Wilkins 2003:621), therefore an artist copying a painting by him would most likely be interested in and have similar ideas to his. Therefore, through deduction, the dating for this painting has been suggested of being anywhere between the ca. 1506 -1750[13] based on its motif, use of nudity, understanding of anatomy, a sketch by Raphael, and the materials used.

[12] This could also be lead-tin-antinomy yellow or lead antinomate yellow. See Original Materials Chapter 4 for more information regarding pigment identification.

[13] Yet, please keep in mind that this is still not a firm confirmation, only an accurate assumption.

4 Original Materials

Only original materials will be mentioned in this chapter. The chapter will be divided up into each individual part of the painting, however, since only original materials will be discussed here; only the original canvas, glue sizing, ground and original paint layers will be addressed. Only these will be discussed seeing that all other parts of the painting[14] are considered secondary in this case and will be discussed in depth in Chapter 5.

Original Canvas

The original canvas was examined visually. It measures approximately 65-67 cm in height, 49-49.5 cm in length and 0.1 cm in depth. It had been previously lined and both canvases were glued directly to the stretcher. For information regarding the canvas' weave, please see Appendix 4 Fig 4.19. No selvedge is present[15], therefore, the warp and weft are not identified. The original canvas is made of hemp. Hemp was identified through visual analysis, and through investigations performed on extracted samples (Appendix 4 Fig 4.2-4.8, 4.17).

However, it is important to mention that although the examinations mentioned in Appendix 4 help support material identification, all extracted original canvas samples were partly covered in extraneous material. This can deter accurate results from being achieved (Mayer 2012:320), therefore this limitation was taken into consideration while interpreting results.

Glue sizing

Since this painting contained a lot of secondary paint, and only small amounts of unretouched original canvas was available for investigation, it was difficult to accurately confirm the presence of the glue sizing. Glue sizing can also be observed from the back of the painting, however, as the painting had been previously lined and was saturated with glue it was difficult to confirm its presence there as well. Yet, glue sizing was often used in paintings from this era, and since there is a lot of loss associated with this painting's past between the original canvas and the ground[16] (Witlox and Carlyle 2005:520), it is likely that it exists in this painting.

[14] Decorative frame, stretcher, varnish layers and surface dirt
[15] A selvedge may have existed prior to the stretcher alterations of sawing its two vertical planks while the painting was attached (See chapter 5). However, this cannot be confirmed.
[16] See Chapter 6

Ground

Through visual examination, and by the examination of the extracted samples using optical microscopy and SEM-EDX investigations (Appendix 3), the ground is most likely calcium (Ca) based, fully pigmented with a dark reddish brown color. This colour is observed through the large amount of craquelure pattern found throughout the painting (Imgs 11, 12, 14 & 18).

From the information gathered, it is likely that the ground has been coloured with burnt umber. Visually, burnt umber is proposed due to the ground's dark reddish brown colour. Yet, it is likely that it can also be related to the intense craquelure pattern found throughout the lightest areas of the painting (Imgs 11, 12, 14 & 18). In these specific areas, it is clear that a reaction has occurred between the ground and the paint layers. As mentioned by van Eikema Hommes (2004:24), burnt umber should not be used in priming materials as it has high oil absorption. Umbers high oil absorption cause problems in paint layers as they can absorb oil from the colours that are applied on top of them (Le Brun 1635:812-813: van Eikema homes 2004:18, 24, 32). Therefore, since this intense craquelure pattern has occurred in the painting's lightest areas, where lead white (a low oil absorbency colour) is likely to have been used[17], a burnt umber ground has a probability in contributing to this type of craquelure pattern found in these areas.

Other reasons why burnt umber is suggested is through XRF and SEM-EDX analysis. Iron oxide is the only inorganic identifiable element found in burnt umber (Helwig 2007:39). And, apart from Ca, Iron (Fe) is also found in all the XRFs (Appendix 2) taken of original paint areas of the painting (Appendix 2). In SEM-EDX, this was confirmed, as Fe was found in large quantities in all of the readings taken from the ground (Appendix 3 Fig 3.12-3.15).

Through investigations of the two extraction samples using optical microscopy, it is observed that only one type of ground has been applied, rather than a two layered ground (Appendix 3 Fig 3.2-3.9). Often single grounds came into use in Italy during the fifteenth century (Stols-Witlox 2012:163). Stols-Witlox (2012:163) mentions that in Italian paintings, natural gypsum[18] was often used in grounds bound with animal glue. Through investigations of the SEM-EDX results this could be a possibility as Ca is found in large amounts in all of the grounds (Appendix 3 Fig 3.12-3.15), yet, aluminium (Al), magnesium (Mg), potassium (K), silicon (Si), and phosphorus (P) were also identified in the ground layers. These elements

[17] See Section Skin tone, under paint layers in this chapter for more information regarding the use of lead white.
[18] Calcium sulphate dihydrate ($CaSO_4.2H_2O$) and natural anhydrite, otherwise known as 'Bolognese chalk' ($CaSO_4$). (Stols-Witlox 2012:163).

could indicate that the artist, while making their ground, blended residues of paint from their palette that were left over, which was a regular practice in the seventeenth century (Witlox and Carlyle 2005:524).

Binding medium

There have only been visual investigations performed on the painting regarding the identification of its binding media. Therefore, no invasive analysis has been performed. Mere visual investigation regarding application technique and thickness imply that the binding medium is oil.

Paint Layers

The paint application technique found in this painting can be systematically observed in the *Colour Stratigraphy Chart* (Appendix 8). Its application is best described as a layered painting technique. van Eikema Hommes (2004) describes this best, stating that common practice involves a three layered technique. The first lay-in of each area is applied in order to isolate the form which usually involves some light and shade (van Eikema Hommes 2004:13). She also mentions the subsequent layers are often applied once the first has dried (van Eikema Hommes 2004:13). The second layer would usually entail an artist to enforce more modeling of the section and achieves the overall final colour (van Eikema Hommes 2004:13). In the third layer the final form is achieved of each area by the addition of finishing's such as highlights, shadows and specific desired details (van Eikema Hommes 2004:13).

In order to completely understand the information found in the *Colour Stratigraphy Chart* (Appendix 8), this section of the chapter will discuss and describe its contents, as well as the reasoning behind possible candidates of original pigments used in this painting. Therefore, each identification number mentioned in the *Colour Stratigraphy Chart*, will be addressed regarding which materials were likely used and also discuss how they were all applied to achieve the final colour. Section 4.4 addressed that all binding media for the original paint are likely oil. Furthermore, please keep in mind that this painting is heavily retouched and contains a large amount of overpainting[19]. Therefore, all information mentioned here can be open for discussion and further interpretation.

Blues

The three main sections of this painting that are considered blue are St. Mary's cloak, the upper landscape and the sky.

[19] See Chapter 5

St. Mary's cloak (Appendix 8 no. 201) has been analyzed using XRF analysis, by visual investigations and by use of photographical imaging techniques. A monochrome blue has been first applied over this entire area. On top of this a modeled light and dark blue, painted wet-in-wet to create form. In order to give the cloak more depth, a selectively placed monochrome blue has been applied in the shadows of the folds of the drapery. Subsequently, only above Jesus's head, yellow brushstrokes are applied ontop of the last layer to accentuate his halo. The XRF (Appendix 2 no. 728) indicates that copper (Cu), Fe, Ca and lead (Pb) are present in St. Mary's cloak. However, through FCIR investigations (Appendix 1 Fig 1.7-1.8), St Mary's cloak transmits a varying degree of magenta. According to Moon (et al 1992) this magenta hue does not indicate azurite or prussian blue pigments as likely contenders as these pigments do not emit a magenta colour in FCIR. Yet, a coloured area can often have a combination of many different types of pigments and the data retrieved by Moon (et al 1992) only involved FCIR of pure tubes of oil paint, not mixtures. Therefore, false interpretations of FCIR images can occur if their data is taken too literally. Azurite[20], blue verditer[4] or Prussian blue[21] are therefore considered as likely candidates since the XRF spectra contain some Cu.

The upper landscape (Appendix 8 no. 202) is also considered blue. It was examined by visual investigations, XRF, in comparisons with FCIR images and SEM-EDX. In order to achieve such a bluish tone in the green landscape, the artist has applied the paint using an initial monochrome opaque light green, with a light green applied over top of this wet-in-wet. As the final layer a translucent blue has been applied selectively in order to help annunciate a more distant upper landscape. An XRF was taken of this area (Appendix 2 no. 717), yet, it was taken in the more lighter areas rather than the blue-green, therefore, it may be inconclusive in providing evidence of elements found in this blue colour. Nevertheless, the XRF's indicate that mercury (Hg), Cu, Pb, and Ca are present. Hg presence has not been thoroughly understood since it is not found in traditional blue paint, yet, as seen in optical microscopy images of extracted paint samples (Appendix 3 Fig 3.2-3.5), the paint in these samples contain many colourful pigment particles. This could mean that like the ground, the artist has not cleaned his brushes properly while applying the paint and left overs of other colours may have been mixed in during application.

Through FCIR investigations (Appendix 1 Fig 1.7-18), this area emits a more purple hue. The blue and greens, provided by Moon (et al 1992) that transmits a reddish blue tone are suggested to be indigo and ultramarine. However, due to the high cost of importing and the long laborious process of extraction the

[20] Azurite and blue verditer are composed of basic carbonate of copper, $2CuCO_3.Cu(OH)_2$. (Gettens and Fitzhugh 1993a:23)
[21] Prussian blue is listed as have a chemical composition of $Fe_4[CN)_6]_3.xH_2O$ (Berrie 1997:191)

pigment ultramarine (Plesters 1993:39; van Eikema Hommes 2004:12) it has been rendered improbable as a possible candidate. The first layer applied, just over the ground in the extracted sample of St. Elizabeths halo (CS-2 yellow) is likely to be considered the first layer of the upper landscape (Appendix 3 Fig 3.19-3.21). This is because St. Elizabeth's yellow halo is understood to have been painted on top of this upper landscape. Under SEM-EDX investigations, this layer most certainly contained Cu and Pb. And since the XRF (Appendix 2 no 717) suggest an indication of Cu in this area as well, it can only be assumed that the pigment used here is either azurite or malachite[22] mixed with lead white[23].

The sky (Appendix 8 no.203) is only blue in its upper half, however, through visual investigations it is understood that the colour applied in the lower half of the sky has been applied all throughout the sky as a base. This part of the painting was studied using XRF and SEM-EDX. The sky has been painted primarily with an opaque reddish-white modelled base colour. With its upper half followed by a modeled translucent blue, subsequently applied with a more darker and opaque blue. Since this original paint section of the sky had the ability of only being investigated after the 2013/2104 treatment process, the XRF (Appendix 2 no 1049) taken of the sky combines the overpainting (therefore this is why zinc (Zn) is present in the spectra). The XRF therefore gave limited results. Yet, it did indicate Cu and, due to the closeness of shade in the upper sky matching the hue in the upper landscape, it could be established that the same blue pigment may have been used in both cases. This is a possibility since, most artist used similar pigments in the same painting.

Sadly, the cross section taken from the overpainted sky (CS-1 blue) were taken from its lower section rather than its upper section. This occurred prior to the knowledge of lack of original blue found in this lower region. This extraction can therefore be seen as having been unethically performed on the painting, since justification for removing such a sample was to identify both an original blue as well as the secondary blue overpainting. Nevertheless, as a student, it has been further understood that cleaning tests of such an overpainted area need to be performed prior to extraction to ensure that all justified reasons are entirely met and extractions are more ethically achieved in the future.

Yet, as you can see in optical microscopy image of the blue extracted sample (CS-1 blue) the original layer found beneath the overpainting has in some areas a blueish tint to it (Appendix 3 Fig 3.2). An attempt was therefore made to ensure a reading on one of the blue pigment particles found within the

[22] Azurite is composed of basic carbonate of copper. Azurite: $2CuCO_3.Cu(OH)_2$ (Gettens and Fitzhugh 1993a:23). Malachite: $CuCO_3.Cu(OH)_2$ (Gettens and Fitzhugh 1993b:183).
[23] Lead white is made of $2PbCO_3.Pb(OH)_2$ (Gettens et al 1993b:67).

sample (Appendix 3 Fig 3.25), however, only minimal amounts of Cu were found. This could either mean that the pigment particle was unable to be read, or that the reading itself may not have hit its desired target. Either way, this could signify that azurite or blue verditer[24] were used in the rendering of the sky. Nonetheless this cannot be accurately confirmed. Other SEM-EDX spectra of the original layer indicate a high amount of Pb (Appendix 3 Fig 3.22 & 3.24) and Hg (Appendix 3 Fig 3.23) found in this layer specifying that the first reddish-white base coat was most certainly applied using cinnabar[25] and lead white[26].

Greens

The two sections of this painting that are considered to be green are the lower landscape and St. Elizabeth's dress.

The lower landscape (Appendix 8 no.301) is a visually identifiable green area in this painting. Like the upper landscape, an opaque monochrome green has been applied, completely covering the dark red ground and on top of this, an opaque light green layer has been modeled to create shape. However, subsequently, a light green and blue green have been used wet-in-wet to create the final touches over this area. This is only identifiable through visual investigations since, this area is considered to be heavily retouched and overpainted. Hence, only the area surrounding St. Elizabeth's head can truly give an indication of the paint application process. And, the data retrieved from the XRF (Appendix 2 no.1024) and the FCIR (Appendix 1 Fig 1.7 – 1.8) may not function as an accurate representation of the section especially since the retouches and overpaint were not removed prior to an XRF reading. Nevertheless, green earth can be disregarded as a possible candidate in these areas since the paintings binding media is oil, and green earth is transparent in such a medium (Grissom 1986:146). More likely candidates for colour are therefore, azurite or malachite[27].

St. Elizabeth's dress (Appendix 8 no.302), has been placed under the green category since St. Elizabeth is usually depicted art historically in a greenish-yellow (Imgs 38-39). The highlighted areas of her gown (Img 13) also look green as they were most likely blended with a more permanent colour such as lead white (Getten et al 1993b:71-72). The rest of the greenish garment colour has most likely discolored over time, since it is now currently represented as black. Artist of the seventeenth century used greens

[24] Azurite and blue verditer are composed of basic carbonate of copper, $2CuCO_3.Cu(OH)_2$. (Gettens and Fitzhugh 1993a:23)
[25] ''Cinnabar, a dense red mineral, is the principal ore of the metal mercury…'' (Gettens et al 1993c:159)
[26] Lead white is made of $2PbCO_3.Pb(OH)_2$ (Gettens et al 1993b:67)
[27] Azurite is composed of basic carbonate of copper. Azurite: $2CuCO_3.Cu(OH)_2$ (Gettens and Fitzhugh 1993a:23). Malachite: $CuCO_3.Cu(OH)_2$ (Gettens and Fitzhugh 1993b:183).

less frequently by substituting a mere mix of yellow, brown, blue and black pigments together instead to achieve there green colour (van Eikema Hommes 2004:78) and this is likely what has happened here. Another proposal is that verdigris has been used, since when it is in contact with sulfur compounds[28], it turns black or brown (CAMEO). Yet, in FCIR St. Elizabeth's garment omits a varying degree of black to brown hue, which does not agree with any of Moon (et al 1992) results for green pigments. The colour application of this area has therefore been difficult to analyze regarding its application and is stated as 'unknown layering structure'' in the *Colour Stratigraphy Chart* (Appendix 8 no. 302). The XRF (Appendix 2 no. 1026) contain Cu making verdigris[29] a likely contender as a pigment used in this area.

Yellows

The only yellows that are found throughout this painting are those that are used in highlights, decor or used to produce all of the figures halo's. However, the highlights and décor used with yellow will be discussed in their respected sections, like those found on the crib and the hair of the figures.

The halo's for all of the figures (Appendix 8 no. 401) are all final layers over the applied layers in their respected areas. Therefore in the *Colour Stratigraphy Chart*, only the seventh layer has been indicated while layers five and six are considered part of their respective areas. Visually, all that can be said about the application of the halos are that they have been drawn with an opaque yellow. An XRF has been taken of the halo of St. Elizabeth (Appendix 2 no. 1029), indicating a presence of both Pb, Fe, Ca, tin (Sn), and maybe antinomy (Sb). Under X-ray (Appendix 1 Fig 1.2), all the yellows in the image emit a similar strong white, indicating similar presence of heavy elements (Stuart 2007:79).

A piece of St. Elizabeth's halo was extracted from the painting (CS-2 yellow) and viewed under optical microscopy and analyzed using SEM-EDX (Appendix 3 Fig 3.3, 3.5, 3.7 & 3.9). The optical microscopy pictures clearly show that there are two layers of original paint found in the sample (one of the green upper landscape, referred to above, and one consisting of a yellow). The data retrieved from the SEM-EDX indicate that the yellow may have been painted with a lead-tin yellow[30], lead-antimonate yellow[31] or lead-tin-antinomy yellow[32], since both Sn and Sb were found in the analysis of this layer (Appendix 3 Fig 3.16-3.18). There has been much debate regarding these types of yellow pigments since it wasn't

[28] In the SEM-EDX investigations it was apparent that sulfur was present in the original paint layer. See Appendix 3 Fig 3.30.
[29] Verdigris composition $Cu(C_2H_3O_2)_2.2Cu(OH)_2$ (CAMEO; Kühn 1993b:133)
[30] Lead-tin yellow has has two types linked to it, type I and type II. The composition of type I is $2PbO.SnO_2$ and the composition of type II is $PbSN_{1-x}Si_xO_3$ (Kühn 1993a; Sandalinas and Ruiz-Moreno 2004:46).
[31] Lead-antimonate yellow has the composition $Pb_2Sb_2O_7$ (Wainwright et al 1986:219)
[32] Lead-tin-antinomy yellow has the composition Pb_2SnSbO_6 (Sandalinas and Ruiz-Moreno 2004:44)

until recently that Sandalinas and Ruiz-Moreno (2004:46) performed thorough investigations with Raman spectroscopy into seventeenth century Italian painting containing yellow Sb and Sn pigments. Stereomicroscope analysis performed by Sandalinas and Ruiz-Moreno (2004:46) mentioned that a 'Pb-Sn-Sb oxide with silica' showed a large quantity of whitish grains made of lead and silica of greater particle size then those among the yellow and orange pigment particles. This description could easily describe the layer of original yellow paint found in the extracted sample take from this painting (Appendix 3 Fig 3.3 & 3.5). Yet, without investigating this sample by the use of Raman spectroscopy it is uncertain of which type the yellow paint, of the three mentioned above, it may be. This is because research show that SEM-EDX have one limitation for their identification, since the line for Sb can sometimes mask the line for Sn especially when tin is present in minor amounts (Sandalinas and Ruiz-Moreno 2004:42). Therefore, this could be why only Sb has been illustrated in two of three spectra (Appendix 3 Fig 3.16-3.18).

Reds

There are two areas that are considered red in this painting. These two areas are St. Mary's dress and St. Elizabeths cloak. Due to the more rose colour of St. Mary's dress and the more orange hue of St. Elizabeth's cloak, both areas are most likely completed using different colours.

Through visual investigations, the application of St. Mary's dress (Appendix 8 no. 501) has been applied using primarily a light red monochrome colour proceeded by a light red modeled colour, applied wet-in-wet. Subsequently, a red glaze was used selectively to produce more shadow in darker areas. Lastly for extra décor in the garment, a yellow has been drawn. Through investigations of XRF analysis (Appendix 2 no. 726) of St. Mary's dress, there were obvious Hg peaks found in the spectra. Hg is an indicator for cinnabar (Eastaugh et al 2008:194). Since, cinnabar is an element with high density (Gettens et al 1993c:159) in X-ray this property will contribute to pigment identification through a rendering of white on the radiograph (Appendix 1 Fig 1.2). Also, through FCIR investigations (Appendix 1 Fig 1.7-1.8), St. Mary's dress omits a strong yellow colour which is a strong probability of cinnabar being used here (Moon et al 1992:50). Yet, due to the fact that this area is visually portrayed as rose in hue, cinnabar has most likely been combined with lead white on the palette.

Unlike, St. Mary's dress, St. Elizabeths cloak (Appendix 8 no. 502) is an orange-red colour. Through the process of elimination, and visual examination, St. Elisabeth's cloak has most likely been applied using an opaque monochrome red iron oxide applied over the burnt umber ground. A mixture of the red iron oxide and lead white has been applied in highlighted areas wet-in-wet over this monochrome colour to

produce shape. Once dried, in order to produce more shadow in the drapery, a red glaze has been applied to shadow. The identification of iron oxide, has been through the XRFs (Appendix 2 no. 722 & 723) taken of this area. The difference between the readings of the two was, that one was taken in a visibly more lighter area rather than the other who was taken in a darker area. In both XRF's, Hg was not identified indicating no cinnabar was present in this area. Therefore, the only candidate most likely to have been used in this area is iron oxide. Yet, Fe is found in all original XRF readings (Appendix 2 no 722 & 723) due to the high likelihood of burnt umber being found within the ground. In FCIR imaging, Fe emits a more orange colour than a yellow hue. And, according to Moon (et al 1992) a more orange tint can indicate red iron oxide as a possibility. St. Elizabeth's cloak does not emit as strong of an intense white in the X-ray (Appendix 1 Fig 1.2), only in the more highlighted areas, which is another indicator that no high density elements are indeed used in this garment.

Browns

There are three areas of this painting that are considered brown. These are: the hair of all figures, and the crib, St. Mary's sleeve and collar, and the tree .Unfortunately, no XRF's have been taken of the brown areas of the painting, therefore pigment identification through these means are limited.

The hair of the figures (Appendix 8 no. 601) can be described as being painted using a modeled dark brown painted over the ground. Subsequently, in order to produce some depth in the hair, slender yellow brushstrokes have been applied over this brown. In FCIR (Appendix 1 Fig 1.7-1.8), the hair of all of the figures are perceived as dark brown, almost black in colour and in X-ray (Appendix 1 Fig 1.2) these areas are observed dark grey. Therefore through these two factors together with comparison done with the naked eye under magnification, the brown colour is possibly an iron oxide.

The crib, St. Mary's sleeve and collar (Appendix 8 no. 602) are also considered brown, although it has many yellow and white decorative elements to it. The application of this area has most likely been performed by applying first a monochrome brown over the ground, then a wet-in-wet combination of a red and brown to give the crib some shape. And lastly white and yellow are used to give the crib decoration, applied with a slender brush. Based on the darkness of the X-ray the pigment used to paint the crib cannot contain any heavy elements, unlike the yellow and white decorative parts which do. It may be safe to say that the same brown, iron oxide, used for the hair of the figures could also have been used here.

The tree (Appendix 8 no. 603) has large amounts of loss and retouches found within it. During cleaning especially, a large amount of filler material was observed in this area (Imgs 15-16). Nothing specific can

therefore be said about the type of pigments involved. Thus, the application layering of the entire tree has been stated as 'unknown layering structure' in the *Colour Stratigraphy Chart.*

Whites

The white areas of the painting are all considered to have been applied the same way. These areas are small and can be described as: St. Elizabeth's veil and sleeve, plus St. Mary's sleeve, headband and patch on her dress (Appendix 8 no. 701). Through visual investigations, this area has been initially applied with a thin translucent brown covering the ground, subsequently a modeling has taken place using a combination of white and grey, wet-in-wet. And, finally to finish things off by adding some depth to the area, white has been drawn with a slender brush. No XRF's have been taken on any of these areas. But the X-ray (Appendix 1 Fig 1.2) emits a light grey to intense white indicating a high probability that lead white is used in this area.

Skin tones

The skin of the four figures, St. Mary, Jesus, St. John the Baptist and St. Elizabeth have all been applied in the same way (Appendix 8 no. 901). A translucent brown has been applied first over the ground with a white modeled wet-in-wet on top of it. A translucent reddish brown has been used to accent shape and warmth in the face, while black is used to accentuate facial features and shadow. XRF's were taken of Jesus' leg (Appendix 2 no.719) and St. John the Baptist's arm (Appendix 2 no.718), yet, no obvious elements apart from Ca, Fe, Pb were found , rendering their data inconclusive. Therefore it is assumed that organic iron oxide pigments were likely used, in combination with lead white for this area.

5 Earlier Treatment and Secondary Materials

It is visibly apparent that this painting has gone through many different types of treatment, both structurally and through visual integration, as there is a considerable amount of different retouching and overpaint. Yet, there is no previous documentation of these treatments, making it likely that they were performed prior to when professional guidelines were set in place for the conservation profession, or that they were in fact performed by a non-professional. Since no documentation was available, this painting has been studied extensively both visually and invasively for indicators of past treatments and the existence of secondary materials. In the following section, these investigations will be discussed as well as an in depth description of each secondary part of the painting.

Decorative frame

The frame is gilded in gold leaf and has a symmetrical decorative design. Four pieces of skillfully carved wood make up its rectangular construction and assembled using 45° angled butt joints (Imgs 4-6). Its structure measures approximately 83.5 cm in height, 62.5-63 cm in length and 4.5 cm in depth. All four pieces measure roughly 7 cm in width. On the frame's lower right hand corner, the museum's registration number is written, A.275 Italia.

This decorative frame has been noted as secondary because of its style, and through comparative analysis of an identical frame found on an Otto Valstad painting located in the museum's café[33]. This second point, if not the first, can suggest that these two frames were purchased and mounted simultaneously, consequently implying that this was performed during Otto's lifetime, and not during the painting's original assemblage.

The painting itself was assembled to the decorative frame by nails that penetrated both into the painting's stretcher and frame (Img 1-6). The painting was mounted to the north east wall of Otto Valstad's main residence at Asker museum by the use of a wire[34], which anchored onto a single nail fixed to the wall. This wire was fastened to the frame by the addition of eyehole screws.

Stretcher

The stretcher is made up of four planks connected with slot mortise-and-tenon joints with keys (Img 5-8). It measures approximately 70.2 cm in height, 49.8-50 cm in length and 1.3 cm in depth. The thick-

[33] See Methods Chapter 2
[34] See Methods Chapter 2

ness of each vertical wooden plank is roughly 2.8-3.5 cm while each horizontal wooden plank measures roughly 4.2-4.5cm. Through visual observations this stretcher has been identified to be made of either pine or spruce. This was concluded through comparisons with other samples (Hoadley 1990:63). The stretcher contained only 7 of its 8 strainer keys.

The exact date of construction of this wooden stretcher is rather difficult to determine. However, since the support shows minimal amounts of mechanical wear and tear, no insect attack, ball point pen marks (Img 7), combined with the observation of several secondary treatments performed on the painting, it can be deduced that it is most likely secondary rather than original. Visually, this stretcher looks newly constructed and the ball point pen marks indicate that they were inscribed into the wood during its construction. There are also no stamps, stickers, handwritten text or other markings that are usually found on stretchers or canvases that are fairly old (Katlan 2012:135).

Previous treatments can also suggest this is an unoriginal stretcher, as common practice at the time of this painting construction suggest that a painting should be stretched and not glued to a stretcher (Cennino1390:103). Therefore, it is highly unlikely that this stretcher is original since it seems illogical why this painting is attached to this type of stretcher in this manner (Img 8).

A hypothesis points to that the stretcher was constructed by Otto Valstad, supported by the existence of another painting in the Asker Museum collection to which the canvas was glued in a similar manner (Skoglund-Johnson 2014). Otto Valstad purchased these paintings, most likely during his travels to southern Europe at the start of the 1900s (Horgen 2006:11). This could suggest that the painting may have been rolled for transportation purposes and upon arrival to Norway, stretched to this auxiliary support and not prior.

This painting and its stretcher also show physical signs of modification. The factors indicating a modification are differences in width and thickness of the two vertical planks (Img 9) versus the two horizontal planks and also the observation of a visible circular saw pattern found on its two vertical planks outer edges (Img 10). This alteration to the stretcher was most likely performed in order to ensure that the painting could fit into the secondary decorative frame, as the painting only just fits into it. Therefore, this modification, secondary treatments and visual investigations all mentioned here, could indicate that Otto Valstad may have constructed this stretcher, making it secondary, and further attached it to the painting by the use of glue.

Stretcher glue

This glue employed to attach the painting to the stretcher can be observed under visible and ultraviolet (UV) illumination (Appendix 6 Fig 6.1-6.2). Under visible light this glue has no colour and is transparent, while under UV light this glue fluoresces a strong white, which combined with chemical spot tests[35], suggest that the glue is proteinaceous.

The secondary canvas, the lining and the lining glue

The painting had previously undergone a complete glue lining and therefore had a secondary canvas support attached to it. This lining canvas measured approximately 70.2-70.5cm in height, 50 cm in length and 0.1 cm in depth. Through thorough non-invasive and invasive examination, it was identified that this canvas was made of hemp (Appendix 4). As no selvedge had been located[36], the actual warp and weft could not be identified. Appendix 4 provides a fiber analysis of the secondary canvas and all information concerning canvas weave and thread count is found there.

Unlike the stretcher glue, the glue used in the lining does not fluoresce as strongly under UV. Visually it was observed through crusty blotches located on the backside of the painting (Appendix 7 Fig 7.1-7.2). Chemical spot tests[37] for proteins and starch performed on the glue suggest that it was not proteinaceous, but does however suggest a cereal based glue (Appendix 7 Fig 7.3-7.5). Glue linings with using starch are well known to have been used in lining of paintings (Reifsnyder 2012:416), therefore this is likely the glue used in this lining.

Losses, retouchings, overpaint and filler material

By visual investigations and through various photo-analytical methods of analysis (Appendix 1), it was clear that this painting had suffered previous losses and been heavily retouched and overpainted. In Img 27, all losses, retouchings, overpaint and filler material observed throughout this painting in the investigation process, prior to treatment are illustrated in a colour coded overview. This was produced in order to represent and understand how much loss this painting has suffered in its lifetime, but also how much secondary material existed as well. In the following sections, Img 27 will be discussed and elaborated upon by separating its secondary paint findings into four main parts. These areas are: retouches that ap-

[35] Explained in Methods Chapter 2
[36] A selvedge may have existed prior to the stretcher alterations of sawing its two vertical planks while the painting was attached. However, this cannot be confirmed.
[37] Explained in Methods Chapter 2

pear directly on the canvas (Img 28), retouches that are performed on filler material (Img 31), overpaint found on the ground (Img 33) and, overpaint over the original colour (Img 32). These sections have been organized and investigated in this manner since it is most likely that previous visual integration campaigns were performed in the same technique and manner due to practical traditions (Fuster-López 2012:590).

Retouches directly on the canvas

These types of retouches can be separated into two categories: those that are on the original canvas, and those that are on the secondary canvas. In Img 28, those areas that are marked in a blue and black vertical striped pattern are those retouches that are located on the secondary canvas, and those that are completely blue are situated on the original canvas. All of these retouchings are easily identifiable through visual investigations since they contain no filler material, and rendering the canvas weave fully visible. It was important to note, that although these two areas of retouchings may seem to have been done at the same time it may not be the case. This is due to the high likelihood that those located on the secondary canvas were presumably performed at the same time as the lining. These retouchings, located on the secondary canvas, also differentiate themselves from those on the original canvas since they are more matt and have no visible overlaying varnish.

X-ray florescence spectra (XRF) have been taken of these areas since here, there is only secondary paint that can be identified as no filler material, original paint, or ground exists. Two XRF of two different colours have been taken of the secondary paint located on the secondary canvas and three XRF of three different colours have been taken of the secondary paint located on the original canvas. For the two that were taken on the secondary canvas, one was taken up top and one on the bottom. There were no major differences found in the two spectra and no accurate pigment identification was rendered available. Both spectra (Appendix 2 no.729 & 1055) contained Fe, Ca, and Zn. However, only in the secondary brown does manganese (Mn) appear to be present. Mn could signify a manganese oxide (Eastaugh et al 2008:796-797), however, Mn is not a reliable pigment indicator since it can be found in a number of different umbers (van loon et al 2012:223) and is often added to paint to accelerate the drying process of oil (van Eikema Hommes 2004:11). Therefore, the only reasonable element found in these spectra are Zn since it is an obvious indicator that these retouching can be no older than the nineteenth century, when Zn was first introduced into paints (Orna and Goodstein 1993:283). And since, it can also be assumed,

that this lining was performed simultaneously as these retouchings, then the lining cannot be considered to have been performed older than the nineteenth century.

The XRFs taken of secondary colours on the original canvas are only of a red (Appendix 2 no.1050), a blue (Appendix 2 no.1051), and a brown (Appendix 2 no. 1052). While analyzing these three colours, the standard Fe, Ca, Pb and Zn were also found. On top of these standard elements, the reds all seem to contain Hg and Mn. Whereas the browns contain Mn and the blue registered traces of Hg.

Losses filled with filler material and then covered by secondary paint

Areas of retouching, where the filler material has been painted over, are found throughout the painting. These areas are marked in Img 31 in white. The filler material is rendered visible in these marked areas of Img 31 since either, 1) translucent colours were deliberately used, 2) they were purposely visibly integrated, or 3) the colours used may have become more transparent over time.

Two XRFs were taken of these areas; a green (Appendix 2 no.1053) and a skin tone colour (Appendix 2 no. 721), over filler material. The green is translucent, while the skin tone colour is a retouching that is fairly opaque. The green contained Ca, Fe, Pb, Zn, and chromium (Cr), while the skin tone contained Ca, Fe, Pb, Zn, and titanium (Ti). The skin tone appears to have been made of several different colours in order to render an appropriate shade of colour, therefore, this XRF may be invalid in rendering an accurate result of a colour. The green secondary colour contained chromium (Cr), which could indicate that it is made of chromium oxide or hydrated chromium oxide[38] (Newman 1997:273). However, all XRF data cannot be accounted for being completely accurate for these samples, since there is difficulty in understanding exactly what each layer contains unless a sample is extracted from the painting of all individual layers and studied under SEM-EDX. And in this case, due to limited time, such examinations of secondary paint were not taken into consideration.

Overpaint on the ground

This type of retouching was only located on areas of the skin of the painted figures. This is most likely due to the contrast in colour between the dark ground next to the lightly painted skin tones rendering the visual aesthetic of the figures. This overpaint used over the ground was therefore most likely meant to soften this contrast and make the figures more aesthetically pleasing. However, these overpaintings on the ground have over time discoloured and this has caused a second disorder in the figures. In Img 33, these types of overpaintings have been identified in a pink hue to differentiate them from any overpaint

[38] Otherwise known as Viridian

placed directly on original paint layers found in Img 32. Although no original paint layers existed under these secondary paints, XRFs would have resulted in plausible element information of these areas, yet, they were too miniscule in order to ensure an accurate reading. Therefore, no XRFs were used to investigate these types of secondary colours.

Overpaint over original colour

A large amount of overpaint stretched onto the original colour from areas of loss where retouchings had been performed. In Img 32, all losses are illustrated in red together with any overpaint covering original paint in a translucent yellow. This combination of the losses and overpainting in this image was to visually clarify how much of this painting's original paint layers were covered. As represented in Img 32, there is a large amount of overpaint that covers the entire original sky. And in x-ray it was clearly visible that the original paint found underneath the sky was still relatively intact, making this a drastic overpainting.

Several XRFs were taken of secondary colours found over the original colour, mainly of the skin tones, blues, and reds. These readings provided little information regarding the secondary colours, since the two layers interfered with one another, consequently obscuring the results, but proved useful when determining the existence of overpaint in some areas, as Zn was detected in all the XRF tests for secondary paint (Orna and Goodstein 1993:283). Nevertheless, due to limited space only one XRF is illustrated in representing these areas of the painting, Appendix 2 no 1056.

However, XRF analysis (Appendix 2 no 716) performed on the blue overpainting in the sky revealed a secondary paint containing nickel Zn, elements known to not exist in the underlying original paint, yet, these findings are not sufficient to suggest the particular paint used. Nevertheless, the paint sample extracted from the sky (CS-1 blue) (Appendix 3) underwent SEM-EDX analysis. The identification of Zn, can be found in all the SEM-EDX spectra, while Appendix 3 Fig 3.27-3.28 showed levels of Al and Si, including Fe in Appendix 3 Fig 3.27-3.29. Yet, it is surprising that Sodium (Na) was not registered in any of the spot readings, considering Na is clearly found in the secondary paint while looking at the mapping of the sample (Appendix 3 Fig 3.30). Based on the elements found, no specific full identification can be reached, as Al and Si could be found in modern paint additives (Learner 2012:248). Yet, the identification of Fe could point to Prussian blue[39], or rather Na, Al, and Si could also point to Ultrama-

[39] Prussian blue chemical formula is described as $Fe_4[Fe(CN)_6]_3.xH_2O$ (Berrie 1997:191).

rine.[40] Nonetheless, at least Azurite, Blue verditer [41], Phthalocyanine Blue[42] as well as Cobalt blue[43] can be eliminated as possibilities, since no Cu or Cobalt (Co) were found in any of the SEM-EDX readings or mappings.

Varnish layers

The identification of the secondary varnishes found on this painting was performed through its appearance in UV illumination and through solubility testing. Its identification as a natural resin varnish is illustrated through its green fluorescence under UV radiation (Appendix 1 Fig 1.3-1.4) (Macbeth, 2012:294). This colour, can usually reason for its likelihood of being secondary as well since only a few decades are all that is required of a resin varnish until they darken and discolour (Phenix and Wolbers 2012:524), rendering the painting unaesthetically pleasing, compelling them to be removed and reapplied. During cleaning tests, these varnishes also proved to be removable with isopropanol, indicating a low molecular weight varnish.

Additionally, another varnish was identified on top of the overpainted areas of the sky. This varnish layer differentiated itself from the rest of the varnishes found over the rest of the painting since under UV illumination it appeared more yellow rather than green in colour. Since this varnish has been applied over an area that containing Zn, it must have been applied after the overpainting, no earlier than in the nineteenth century (Orna and Goodstein 1993:283).

[40] Ultramarine's chemical composition is generally depicted as $Na_{6-10}Al_6Si_6O_{24}S_{2-4}$ (Plesters 1993:55).
[41] Azurite and blue verditer are composed of basic carbonate of copper, $2CuCO_3.Cu(OH)_2$. (Gettens and Fitzhugh 1993a:23).
[42] Phthalocyanine blue has a chemical composition of $C_{32}H_{16}N_8Cu$ (CAMEO).
[43] Cobalt blues chemical composition is $CoO.Al_2O_3$ (Roy:2007:151).

Earlier Treatment and Secondary Materials
Virgin and child with St Elizabeth and infant St John the Baptist, in a landscape – Asker Museum

6 Condition Assessment and Treatment Proposal

Prior to undertaking any treatment the painting underwent a condition assessment. This assessment was performed in order to understand and justify any remedial treatment the painting required. It also was performed to recognize what preventive measures could be undertaken in order to further preserve the painting. For each section of the painting, all damages will be described, and an overall grade of that section will be given. This grading system is based on information attained from a chapter in Keenes book (2002:139-171) concerning collection management and the assessment of overall condition of museum collections in general. Disregarding that this evaluation technique is generally performed on collections on a whole, its procedure has been adapted and applied here to evaluate each fragment of the painting separately. By using this method of characterization, a comparable platform is thereby fixed where all areas of the painting can be juxtaposed against one another. This platform can therefore help organize and prioritize the urgency of remedial treatments that this painting requires by ensuring that each treatment that is proposed is accomplished ethically (AIC 1994; ECCO 2002) and also efficiently.

These grades are based on a scale of 1 – 4, making a point not to use a scale of 1 – 5, where it can be tempting to use the grade 3, indicating neither good nor bad (Keene 2002:148). When each section of the painting is graded, its grade will reflect Keene's (2002) description.[44] Consequently, included at the end of each section, a treatment proposal will be suggested based on the grade given and relevant information found in preceding chapters.

Secondary decorative frame

The secondary decorative frame has been given a condition grade of 2 (fair). It was obvious, through visual investigations that this decorative frame was in a fair condition (Img 1). Only small amounts of dust had piled up over the years, minor wooden plank deformations had occurred, slight craquelure had appeared, and no major areas of flaking paint were observed (Img 3). Its corners[45] (Img 4-6) and its unaesthetically pleasing and structurally vulnerable backside (Img 2), were where this frame had its faults. Yet, to make things perfectly clear, this frame was considered solid, had no major risk regarding loss of

[44] Grade 1 (good) – meaning it is in good condition, or is stable; Grade 2 (fair) - a condition indicating disfigurement but stability, resulting in no immediate treatment Grade 3 (poor) – implying a condition that should restrict use, has a high probability of being unstable and remedial action is desirable; and lastly, Grade 4 (unacceptable) - where it is considered a severely weakened and/or highly unstable condition, where immediate remedial action should be taken (Keene 2002:148).
[45] Where the four planks are joined

original materials and looked as though it could manage handling. This was why it was given a grade of 2 (fair).

Through investigations of visual analysis it was observed that a piece of plaster was missing, and ultimately lost, from the decorative design in the frames top left hand corner (Img 4). In this corner, the 45° angled butt joint had separated, rendering its construction visible from the front.

The wire that is used to secure this painting to the wall is wrapped in a textile (Img 6). This textile surrounding the wire was deteriorating. Deterioration is especially noticeable around the area where the wire is bent and rests upon the nail when mounted to the wall. However, only the textile and not the wire itself looked damaged in these areas, as the wire was merely bent, and can therefore be considered solid and dependable.

The painting itself was attached to the decorative frame by nails that penetrated both the paintings secondary auxillary support and this decorative frame (Img 5-6). However, in order to remove the painting from the frame, these nails had to be removed and left empty holes and mechanical markings in its place. Previous holes such as these are rather sparse on the frame, indicating either little use, that it is rather new or that the same punctured areas have been used over and over again.

Several dead insects were found after the painting was removed from the frame. Larva and egg capsels were dried up and dead between the stretcher and the frame (Imgs 44 & 45). Unfortunately, due to time restraint the insects were not accurately identified.

Treatment proposal for the decorative frame

This frame could have been considered a grade of 1 (good) however, in order to help preventively protect this painting against future threats, parts of its remedial treatment need to be prioritized. Its superficial treatment of dirt removal will be considered lowest priority during this 2013/2014 treament as it is mainly concerned with the paintings structural welfare and not its aesthetic appearance. However, in order to protect this painting, an additional backing board will most likely have to be installed either to this decorative frame or the stretcher, providing the painting with a more stable environment, especially since it is hung on an outside wall. Therefore, the wire, although stable, may have to be switched out with another dependable mounting system.

Secondary stretcher

The secondary stretcher was given a condition grade of 4 (unacceptable). No serious amounts of dust, grime or dirt (apart from the stretcher glue) were found on the stretcher, implying that it was possibly newly constructed. And, there were also no traces of insect markings, or severe mechanical wear and tear. Nevertheless, the secondary stretcher was given a grade of 4 (unacceptable) as it was not entirely sturdy. This grade also reflects the attachment of the painting to the stretcher in an undesirable manner, discussed further in the section 6.4.

The stretchers strength was questionable, since it was homemade and its longitudinal wooden planks were far thicker than its vertical wooden planks (Imgs 7 & 9). These wooden planks also varied in thickness[46], suggesting a weak and less solid stretcher when compared with industrial stretchers produced today. Likewise, the secondary stretcher showed minor signs of cracking, further questioning its strength, found in its corners and edges where the strainer keys had been inserted (Imgs 7-8). Equally, all the wood[47] used for this auxiliary support had *not* been sanded down, implying that some surface areas were fairly splintered and rough in texture (Img 8). These areas posed risk with regards to potential future damage as physical contact of these areas with the canvases could easily result in tearing.

As mentioned in chapter 2 and 5, the painting was not attached to the stretcher in a conventional manner by way of nails or staples; it had been glued (Img 8). And although the original painting had a secondary canvas supporting it, the wooden stretcher's surface areas were in full contact with the canvases. Therefore, since the painting was locked into place with glue, deterioration through surface tension was a concern for the canvases wellbeing.

Treatment proposal for the secondary auxiallary support

After having been given a grade of 4 (unacceptable), this secondary stretcher will have to be switched out with a new auxiliary support. This is proposed since a new stretcher will provide the painting with the strength and support it requires. This new wooden stretcher will also contain a uniform beaded edge ensuring that full contact of the original canvas is not achieved.

[46]This is a result of them being sawed to fit the secondary decorative frame. And, it should also be noted that this sawing was performed while the painting was glued to the stretcher. This could very well indicate that this mounting was most likely not performed by a professional conservator.
[47] Even the 7 of 8 keys used the stretcher

Canvas

For the purpose of this section, the two individual canvases will be discussed separately with regards to visible damage, pH, thread folding tests and their thread counts. However, due to previous treatments performed on the paintings, there is a section dedicated to discuss how their condition was influential with one another. In this section the lining as well as the damage caused by the canvases being glued to the stretcher will be discussed.

Original canvas

The original canvas has been given a grade of 3 (poor). Its weave structure and thread count can be found in Appendix 4.

pH strips were used to test the acidity of the original canvas (Appendix 5). Through the use of pH strip testing the results of the original canvas were relatively acidic (pH 5.5-6.5). This increased acidity could therefore very well be due to the addition of the secondary support by performance of the glue starch lining.

A thread folding test was performed to test the elasticity and brittleness of the original canvas threads (Appendix 4). Both a horizontal original and a vertical original thread were tested. The test concluded that the horizontal thread had a category 3[48] and the vertical thread had a category 4[49]. According to Oriola (et al. 2011:3) this illustrates that the original canvas is in good condition, but that it could possibly be somewhat fragile, and stretching should be performed carefully.

The categories allocated for the original canvas through the thread folding test were of no great surprise, as the canvas was most likely woven in the sixteenth, seventeenth or eighteenth centuries[50], making it at least three hundred years old. Nevertheless, seeing that the original canvas lacked tacking margins, it is important to point out that no pure original canvas threads could be extracted from the lined painting. This is because the whole canvas was covered in either original or secondary paint (Appendix 1 Fig 1.1) Hence, the extraneous material found on the canvas may have impacted the thread folding test results negatively or even positively, due to chemical interactions with the two materials (Mayer 2012:320). Therefore, this limitation was taken into consideration when labeling this canvas as a grade 3 (poor) rather than a grade 2 (fair).

[48] Category 3 Appendix 4
[49] Category 4 Appendix 4
[50] See Historical context chapter 3.

Secondary canvas

The secondary canvas has been given a condition grade of 3 (poor). The thread count taken for this canvas can be found in Appendix 4.

Through pH strip testing (Appendix 5) the results proved that the secondary canvas had a pH level similar to that of the original canvas (pH 5.5-6.5). However, the lining glue was far more acidic (pH 4.3-5.3). Since the glue was more acidic than the canvases themselves, its presence would likely encourage deterioration. Consequently, this can advocate for the removal of the lining.

For the secondary canvas, the results were quite similar to that of the original canvas (Appendix 4). The results were that the horizontal thread had a category 2[51] and the vertical thread had a category 4[52]. Which according to Oriola (et al. 2011:3,5), meant that this canvas could possibly be in good condition, but that there is a possibility that stretching may lead to tearing. Ideally, a secondary canvas should receive a category 4 in such testing to ensure that it's function is meaningful in providing the original canvas with proper support and stability Therefore, these results assume that the secondary canvas is not in as a good condition as visually observed and also why it has been given a grade of 3 (poor).

The lining

There are elements along the edges of this painting that indicate wear and tear of the original canvas (Imgs 40-43). These are likely to have formed from when the painting was originally stretched to its original auxillary support, or could also be a result of the lining. The lining is considered a possibility since the use of hygroscopic vegetable glue (Reifsynder 2012:416) as a lining adhesive can react in considerable dimensional differences within the canvas, especially when enclosed in a fluctuating relative humidity (RH) environment (Appendix 9). Fluctuating RH will ultimately cause tearing along the tacking margin when tacks are used (Phenix 1995:25). However, since the tacking margins are missing from this painting, as they were either sawed off[53] or painted over[54], nothing can be said for certain whether this was in fact the cause of these tears. Nevertheless, tears are found throughout the original canvas and the use of vegetable glue as a lining material is considered influential in the poor grade given to the original canvas.

[51] Category 2, Appendix 4
[52] Category 4, Appendix 4
[53] See Secondary Materials Chapter 5
[54] See Secondary Materials Chapter 5

However, it is apparent through comparison with another painting, found in the Asker Museum collection, and conserved simultaneously as this painting[55] that this previously lining may have proven to be beneficial in the preservation of original paint layers. This is because this other painting was not lined and was attached similarly to its stretcher by the use of glue. Differences were observed regarding the cracking, lifting, flaking, tenting and cupping found along the edges of these two paintings (Helene Skoglund-Johnsen 2014). Nonetheless, it should also be understood that through investigations of raking light, the original canvas was clearly not evenly adhered to the secondary canvas (Imgs 25-26). This is not ideal as the lining is therefore causing more harm, and malfunctioning in providing the painting with additional support.

Treatment proposal concerning the original and secondary canvas

In conclusion, the treatment proposed for the safeguarding of the original canvas is the removal of the lining, and the removal of the lining glue found on the original canvas. This is suggested since the glue used in the lining is far more acidic then the original canvas itself. The original canvas is also not evenly adhered to the secondary canvas causing deformations. Also, vegetable glue is not ideal for a fluctuating environment, such as the Otto Valstad Atelie (Appendix 9). A trip-lining should be performed in order to stretch this canvas, as it does not have any tacking margins and so that it can be stretched to an auxiliary support in a conventional manner. Accordingly, less damaging materials and reversible materials should be used in accordance with the paintings current environment and original materials.

The gluesizing, the ground, and original paint layers

A fair grade of 2 has been given to the glue sizing, the ground, and the original paint layers combined. This grade is primarily associated with large amount of paint loss, retouchings and overpaint visible throughout the painting (Imgs 27 & 46-49). However, no current lifting, tenting or cupping are observed in the painting. This indicates that its condition is good. Yet, a lot of previous loss is observed in this painting, where secondary paint has either been applied directly on the bare original canvas, or ontop of filler material (Imgs 46-49).

Delamination and glue sizing

In its present state, delamination of the ground/paint layers from the original canvas seems stable, which is a motive for giving a grade of 2 (fair) rather than 3 (poor). According to the literature (Ackroyd and

[55] Please see Helene Skoglund-Johnsens, Konserveringen av et maleri på lerret I Otto Valstads atelier, regarding the effects the same mounting had on her unlined painting.

Young 1999:265; Mecklenburg 2007:20-21), a cause associated with loss of paint (between the ground/paint layers and the canvas) is directly related to the glue sizing. A glue sizing's function is to protect the threads of the canvas so that the ground is not fully absorbed (Witlox and Carlyle 2005:520). In high RH (80%), glue sizing becomes more viscous thereby resulting in paint loss (Mecklenburg 2007:20-21; Ackroyd and Young 1999:265). Since, the measuring of temperature and RH in the paintings current environment does not show higher RH then 64%, then it is likely that the glue sizing has not become viscous and no paint loss has therefore arisen (Appendix 9). This can only mean that the glue sizing layer found in this painting has remained stable for quite some time and the RH found in the atelier has proven to be a beneficial environment for the glue sizing. Nevertheless, it is obvious that this painting has suffered this specific type of delamination damage in the past as it has massive amounts of loss between the canvas and the ground. All the same, there is no way of knowing if this loss may have occurred when the atelier was in use by Otto Valstad at the start of the twentieth century, or when the painting was in another person's possession.

The ground

Through visual investigations of the ground, it seems to indicate that it is in a good condition. But since the ground, for the most part, is hidden under the paint layers it is difficult to have a full understanding of its condition. Yet, it can be concluded that since the majority of the painting does not show signs of lifting, tenting or cupping, it can be implied that the ground and paint layers currently have a good bonding power.

Craquelure

The paint layers and ground can also *not* be considered having a condition grade 1 (good), as there are obvious ageing and drying craquelure patterns in varying degrees throughout the painting (Imgs 11, 12, 14 & 18). Due to the likelihood that burnt umber was used in the ground[56], the skin toned areas are thereby considered regions that where drying craquelure is observed. These areas are distinct from others since the craquelure only penetrated the overlaying paint layers and not the ground.

Spike Bucklow (1997:129), has examined craquelure patterns intensely and specifically focused on their connections with traditional painting techniques. He has made a point of creating a list of 8 easy dichotomies used to classify and describe complex craquelure patterns found within paintings (Bucklow 2000:61). However, as mentioned earlier, in the canvas section, the stretcher glue may have played a

[56] See Original materials Chapter 4

role in canvas' movement[57] and not just the use of materials and techniques can be considered. It also seems that the crack formations in this painting followed the canvases' weave pattern in most areas which might suggest that the previous lining contributed to the paintings craquelure pattern. Therefore, these additional factors can make it more difficult to place the craquelure found in this painting into any of Bucklows (1997:129;2000:61) specific characterizations of craquelure.

Treatment proposal concerning the glue sizing, ground and original paint layers

Therefore, through visual investigations regarding the paint layers, the condition of this paintings glue sizing, ground, and paint layers are considered to be in a fair condition. The painting is also benefitting from the environment that it is currently displayed in, as the RH has not been measured of being above 80% (Appendix 9) in a 9 month span. Therefore, no immediate consolidation is required in the 2013/2014 treatment, yet, continuous re-evaluation must take place during treatment, and local consolidation should be performed if necessary.

Secondary paint

The secondary paint has been given a condition grade of 2 (fair), 3 (poor) and also 4 (unacceptable). All retouches and overpaint were easily identifiable either visual investigations and through photoanyalytical examinations (Appendix 1). Their fluorescence in UV, and colour and texture in visible light were often different from the original, rendering them visible to the naked eye. These characteristics are most likely due to their application 1) when the painting was varnished, creating a different valour, or 2) at time when the paintings original colours had not changed as drastically as they have now, or 3) that the varnish has altered to such a degree exaggerating the difference and rendering them identifiable (van der Goltz and Stoner 2012:497).

According to standards of ethics put forth in conservation, secondary paint should not cover intact original paint (AIC 1994; ECCO 2002). And it is in these areas that secondary paint have been given grades of 4 (unacceptable). Other unacceptable factors include secondary paint that cause increased degradation of the original materials as well. However, the composition of the all the secondary paint used has not been analyzed. Areas where secondary paint is on top of filler material or original canvas, have been given grades of either 2 (fair) or 3 (poor). Grades of 3 (poor) are in areas where retouchings are heavily discoloured. Grades of 2 (fair) are in areas where discolouration is not present and their presence contribute to the aesthetic, conceptual and physical characteristics of the work of art (AIC 1994).

[57] The glue lining and the attachment of the painting to the stretcher by the use of glue

Treatment proposal for the secondary paint

The suggested treatment for these retouching is that those that cover original intact paint should be considered removed. Also, the removal of retouchings that do not cover original paint will have to be deliberated upon as well during the 2013/2014 treatment. However, these can be more based on their solubility capabilities as well as their aesthetic appearance. Also, due to the large amount of retouching's found on this painting, considerations will have to be made regarding their removal with respects to time management and personal retouching skill of the author.

Secondary varnish layers

The secondary varnishes have been given a condition grade of 3 (poor). Through mere visual examination and ultraviolet illumination (UV) it is apparent that the varnishes found throughout this painting are heavily degraded. It can be visually observed in all the white pigmented areas of the painting that the varnish has discolored since the white areas appear yellow rather than white in visible light (Img 20). As two varnishes are likely to have been used on this painting, a heavy green[58] and yellow[59] fluorescence is also well represented under UV (Appendix 1 Fig 1.3-1.4).

Treatment proposal for the secondary varnish layers

The varnish layers in this painting should be removed. However, due to the large amount of retouches and overpaint found throughout the painting, a selective approach may have to be taken into consideration. Yet, this will have to be deliberated upon once varnish and secondary paint removal in the 2013/2014 treatment has begun. This is because personal aesthetic opinion, solubility and time management will have to be taken into account for all retouches found within the painting.

Surface dirt

The identification of surface dirt found on the painting has been given a condition grade of 4 (unacceptable). Considering surface dirt can be a visual disturbance (Eastaugh 1990:19) but also cause damage to paintings (Thomson 1986:143-145) this layer of the painting has therefore, been given a grade of 4. Through visual examination of the painting it was apparent that the painting's front and backside were moderately dirty. Yet, the surface dirt was not visually disruptive to the painting technique, its palette, motif, and understanding of varnish fluorescence in UV.

[58] The green fluorescence is represented in the majority of the painting, apart from the sky.
[59] The yellow fluorescence is represented only in the lower part of the overpainted sky.

Also, no intrusive analysis was undertaken regarding the exact type of dirt particles found on the painting. But, conservation scholars mention the general surface dirt components of being comprised of soot, fat, stains, glue, nicotine or dust (Perry 1990:3; Ashley-Smith 1996:14). The fire pit used in the Asker Museum twice a year (Benterud 2013 personal communication; Horgen 2013 email) could very likely be the source of circulating soot in the room. And, since the painting is also attached to an outer wall, circulating dirt is attracted to colder areas (Perry 1990:3); thereby making it likely this painting has accumulated dirt, both on its back and front because of this colder air. Also, through visual observation, a wax stain was observed on the painting, this was most likely from a dripping candle (Img 19).

Treatment proposal for surface dirt

Prior to varnish removal, the painting should be cleaned with saliva. This will ensure that the majority of the surface dirt has been removed from the paintings surface. This will especially be important if the painting is to be selectively cleaned. Also, during treatment, the painting should be covered with a melinex sheet to ensure that surface dirt found in the conservation Atelie does not accumulate on the surface, especially when cleaning has started.

Conclusion

Based on the grades given above, structural treatment will be primarily given more precedence above all other treatment. Subsequently, aesthetic treatment will also be considered yet, it is understood that this involves more subjectivity and will be proceeded upon with more caution in order to ensure personal taste or opinion regarding the painting is limited (AIC 1994: ECCO 2002). Secondary materials will primarily be removed when they are disruptive to original materials integrity and replaced, when needed, with more ethically correct materials.

7 Treatment 2013/2014

The results of the investigations embarked upon on the identification of the painting materials and those established in the condition assessment were influential regarding the exact execution of the paintings 2013/2014 treatment. They were especially persuasive regarding the choice of conservation materials to be used. However, the treatment was also performed in accordance with research on conservation literature and through discussion of treatment options with the current owner. In addition, due to personal standards regarding health and safety, the materials used in the 2013/2014 treatment were also heavily considered upon their hazardous qualities.

Structural treatments were prioritized during this 2013/2014 treatment as they were considered more objective over cleaning and visual integration undertakings. However, due to the large amount of retouching and overpaint found throughout the painting, cleaning and visual integration had to be performed. However, these undertakings have been heavily deliberated upon. All materials used in this 2013/2014 treatment can be found in Appendix 10.

Structural

For the purpose of stability and longevity, intrusive structural measures were necessary to be performed on this painting. As mentioned in the Chapter 5 and 6, this lined painting was attached to its secondary stretcher not in the traditionally manner, but by the use of glue which had the potential of ultimately leading to detrimental effects regarding deterioration if not removed. The painting was also lined using a starch based glue, which is considered a hygroscopic material that is undesirable in relation to paintings current fluctuating RH environment (Appendix 9). Therefore, in order to stabilize the painting structurally, the painting was delined, and a strip-lining was performed using more reversible and less damaging materials. These will all be discussed in the following section, including arguments supporting the materials selected during the process.

Facing

Since the structural treatment of the painting required it to be intrusively worked upon on a numerous amount of occasions, two types of facings were used. These two types of facings were that of Lascaux 375[60] in white spirit[61] and also sturgeon glue in distilled water[62] (Img 50 & 51). The use of Lascaux 375

[60] Lascaux 375 is the most likely the Lascaux adhesive described by Berger that took on the name Beva (Berger 1995:26) due to its main components. Beva 371 solution is made of ethylene vinyl acetate copolymer, Cyclohexanone resin, Ethylene

facing was chosen during the structural treatment of the delining process and the glue removal process. Its choice was heavily reliant on the assurance that the facing would not be affected by the use of water, isopropanol, and ethanol used on the back of the painting. Sturgeon glue was selected as a facing at another stage of the structural treatment process due to its less hazardous qualities rather than its contingency of being dependent on the materials used during the treatment. It was used during the removal of the temporary mounting and at this point in the treatment the understanding of the original paint layers strength and attachment was clearly established. This knowledge brought confidence in knowing that the risks of using a non-hazardous material would outweigh the likelihood that the facing would malfunction.

Delining

For the purpose of stabilizing the painting structurally, the painting was delined; thereby removing it from its unstable mounting. This was advised since the painting was 1) not properly attached to the secondary canvas, 2) the material used in the lining were identified as hygroscopic material and, 3) attached to the stretcher by the use of glue. Therefore, justification was apparent as a beneficial remedial treatment procedure in order to limit further deterioration. The delining was performed mechanically, using a spatula together with minimal[63] amounts of water and isopropanol when needed. A mechanical delining was chosen, since brittle glue shatters more easily when dried than the original paint (Hackney 2012:437). Water was used as starch is soluble in water, and isopropanol was used to dissolve secondary paint that had acted like an adhesive in areas where retouches were previously painted directly onto bare original canvas. Please see Imgs 52 & 53 illustrating the delining of this painting.

After the initial canvas removal, it was important to also remove as much of the previous lining glue as well as the glue used in the attachment to the stretcher, since these glues had saturated themselves into the original canvas. After conducting removal tests[64], the material that seemed to function best was a Klucel J mixture, mentioned by Berger (2000:336)[65]. This substance was chosen over the other two tested materials, primarily due to its capability of removing the glue effectively. The execution of the glue

vinyl acetate copolymer, Phthalate ester of hydroabietyl alcohol, and Petrolatum (Paraffin). While Lascaux 375 is made of a base of ethylene vinyl acetate copolymer, cyclohexanone resin, phthalate esters of hydroabiethyl alcohol and paraffin.

[61] See Appendix 10

[62] See Appendix 10

[63] It is difficult to say exactly how much was used. It could be described as a few drops in a selected areas that required too much force with the spatula then needed. A good half of the original was already detached from the painting, so you can roughly imagine how little water and isopropanol were needed.

[64] Three substances were tested – Laponite RD, Agar Agar and Klucel J.

[65] See Appendix 10

removal required the Klucel J mixture to be alternatively placed in approximately 3 cm x 4 cm areas on the back of the painting and sit for 20 minutes. Subsequently, its removal was performed first by scraping off the majority of the gel from the back of the painting with a spatula and then by rolling cotton swabs with minute amounts of water over the once covered area. Please see Img 56 & 57 regarding the removal of the glue lining using the Klucel J mixture.

Consolidation

As the condition assessment of the original paint layers illustrated that the painting did not require initial consolidation prior to the delining, consolidation of the paint layers only took place after the performance of the delining treatment. The consolidation therefore was performed simultaneously while removing the Lascaux 375 facing. Only small samples of original and secondary paint layers had attached themselves to the facing during the structural treatment process thereby demanding only minimal consolidation treatment. The material used for consolidation was Lascaux Medium for Consolidation (MFC) together with white spirit functioning as a wetting agent. This material was selected as the glass transition temperature (T_g) of the MFC medium is 4°C (Hedlund and Johansson 2005:436). This has been identified as being suitable for the Asker museum environment that the painting is currently displayed in, since the lowest registered temperature was 8.8°C according to 9 months of accumulated measurements taken of that same room (Appendix 9). The T_g of a material is significant as T_g is when a substance shifts from a rubbery to a more glassy state (Young 2012:24). Therefore, it is ideal to understand such information and compare it with the measurements taken of the paintings current environment to further ensure that MFC will not stiffen; thereby malfunctioning as a consolidation medium.

Temporary mounting

After having removed the painting mechanically from the previous lining it was important to make sure the painting was kept stable during the performance of its cleaning[66]. Therefore a water based paper tape, made of brown craft paper was attached to the back of the painting temporarily and applied similarly like a strip-lining. Yet, cutouts of the brown craft paper were evenly placed at right angles that extended to the working stretcher [67] (Img 54 & 55). This temporary water based paper tape kept the painting stable during cleaning by providing an even amount of load on the painting and generated minimal movement. This type of working stretcher also made it possible to work on both sides of the painting

[66] Both varnish and secondary paint removal, but also during the removal of the previous lining adhesive.
[67] The type of method is usually referred to as a modification of a Dutch Strainer which was generally used during lining procedures. However, this required the craft paper to be placed on the paintings front, rather than back.

simultaneously, which is why it was especially chosen. A strip-lining would have been more ideal, yet the use of heat in the attachment process posed the risk of unidentified secondary paint of cross linking along the edges of the painting. Therefore, it was disregarded until these areas of the painting could be cleaned of its retouches first. It should also be important to mention that whilst the painting was mounted to the temporary stretcher, it was continuously put under pressure, when it was not being worked upon in the event of deformations occurring within the canvas structure (Img 58).

Strip-lining

Once the painting was cleaned both on its front and verso, the painting needed to be stretched to a new secondary stretcher. And, considering the painting 1) had been previously glued directly to its previous stretcher, 2) did not have any tacking margins and 3) was requested by the museum to be displayed in its secondary decorative frame, it had to undergo a strip-lining in order to fit this new auxiliary support. A strip-lining was chosen since the paintings original canvas and original paint layers seemed to not require excessive support (such as a lining) but required additional material in order to be properly stretched to the auxiliary support. Simultaneously, a strip-lining is considered less intrusive, and the minimal administration of an adhesive to the paintings backside would subdue any rapid alteration of the original canvas' already elevated acidic pH levels (Appendix 5).

The materials used for the strip-lining were polyester sailcloth and Beva 371 film. Polyester sailcloth was selected since it considered isotropic; meaning that it has the same properties in all directions (Hedley 1993C:80). Sailcloth is also inert to variations of RH and temperature (Hedley 1993C:77; Daly Hartin et al 2011:8; Hackney 2012:435) thereby making it less effected by the fluctuating climate where the painting is currently displayed (Appendix 9). Young (1999:83) states that the choice of a strip-lining material can be based on using a material that transfers the weight away from the original canvas, which polyester sailcloth provides. Simultaneously, Hedley (et al 1993:53) believes that polyester sailcloth will withstand a motion of 3% without deformation, and the absorption of moisture does not exceed 2% at 100% RH. Making polyester sailcloth, a more justified material to use, rather than linen[68], by causing less damage throughout the original painting when placed in the Asker Museum environment. In Appendix 9, it is observed that the RH in the paintings current environment has not reached a level of 100% RH.

[68] A hygroscopic material

The use of Beva 371 film[69], as an adhesive, was deduced primarily since it is considered reversible and is applied in a very clean fashion. Beva 371 is reversible due to the nap bonding effect it has during application processes, where only tips of the film attach themselves to the canvas, rather than impregnating themselves into the textile materials (Scharff 2012:445). Beva 371 film is categorized as a class-A material (Appelbaum 2007:320). Class-A materials are based on Fellers tests and are considered to have a lifetime of at least 100 years (Feller 1994:6). Together with other students, tests were performed on different types of application processes using relevant and available adhesives[70]. However, during testing it became clear that these materials were either visibly penetrating the test canvas materials or were fairly messy in their application process, therefore they were disregarded. Please see Imgs 60-63 regarding it's the strip-lining.

Stretching

The previous auxiliary support, with regards to its condition[71], was switched out with a new stable stretcher. This stretcher contained a uniform beaded edge, ensuring that the painting, when stretched, would not have full contact with the auxiliary support subduing the development of stretcher bar marks. During the 2013/2014 treatment it was stretched in the traditional manner attaching the painting to the stretcher by use of staples (Buckley 2012:153). Each staple has been inserted through the canvas and into the stretcher simultaneously with an underlying piece of blotting paper. And although each staple is made of stainless steel, the blotting paper was employed to even further reduce any immediate likelihood of corrosion (Img 59).

Mounting and backing

Alterations have been introduced to the back of the painting in order to introduce an environmental buffer to the painting but also to protect the painting during handling (Dixon 2012:728). A backing board, made of polycarbonate, and four corks have therefore been attached to the paintings construction (Img 77). This backing board has been added in order to create a slight micro climate for the painting since it is hung on an outer wall in hopes of preventing mold growth and minimize surface dirt (Mecklenburg 2007:19). While the corks primarily help to ensure that the backing board functions as it should by warranting a more even flow of circulating air behind the painting. As the painting is hung by one single

[69] An adhesive composed of ethylene vinyl acetate, developed by Berger in 1968 (Berger 1975: 126). Beva 371 film is dried Beva 371 gel placed between two silicon sheets (Berger 1975: 127).
[70] Three substances were tested – Lascaux 498, Lascaux 360HV, and Lascaux 375. Applied using spray, brush and rolling pin. Please see Appendix--- Section 2 for recipe.
[71] See Chapter 6

wire attached to the wall, the corks also function in supporting the painting in a more even fashion without having its top protruding far more out from the wall. Their attachment is easily removable, if undesired by the museum.

Cleaning

Once the painting was firmly attached to its temporary working stretcher, the removal of the varnish layers and secondary paint took place. The cleaning of the painting proved to be time consuming. Not necessarily due to the varnish removal but rather concerning the contemplation regarding the removal of all of the secondary retouching and overpaint found throughout the painting (Img 27). The varnish was removable fairly easy with isopropanol but rather the secondary paint found all over the painting proved slightly difficult to be removed as there were so many variations in the secondary paints solubility. Therefore, although taken, no clear cleaning tests were possible to be well representative and clearly documented as the solubility of the retouches had to be identified simultaneously as the cleaning 2013/2014 treatment was taking place.

Selective cleaning

In the 2013/2014 treatment, the painting was selectively cleaned (Appendix 1 Fig 1.3). This choice was based on the stability of the varnish layer, combined with lack of time and a desire to preserve some of the paintings history. It became clear through investigations of overpaint and retouches, that treatment involving the retouching of all the losses of this painting, after varnish removal would require a great deal of time. Also, since the varnish layers were not considered to be as visually disruptive to the paintings overall understanding, and distinctions between how much yellow is too much can be considered relative (Hansen-Bauer 1996:168), a selective cleaning was justified. The darkened varnish would aid in the identity of the artwork being as old as it once was, especially seeing that it hangs in a historic house among old things. Also, since this painting had been heavily retouched before, possibly by Otto Valstad himself, it was regarded that this painting would benefit in a selective cleaning in order to preserve its past. As an additional consideration was taken into account regarding the removability of the varnish with a lesser polar solvent (iso-propanol), therefore it could be concluded that the varnish was not as heavily oxidized as once thought. The painting is also hung in a very poorly lit area of the room, which reasonably concurred why oxidation is not happening as fast. Hedley (1990A:152) has discussed extensively the advantages and disadvantages concerning the aesthetics related to partial, selective and total cleaning of a painting. And, with reference to Hedley (1990A), the reasons argued for here are not gen-

erally those chosen when justifying a selective cleaning procedure, however, it seemed important to uphold the paintings evidence of its past.

Caple (2000:62) discusses the truths found within a cultural object, as encompassing evidence from all stages of its existence, as no single object exists for a single moment. He also states that within a historic house where rooms are filled with vast amounts of numerous objects, and paintings from different styles, they all have one thing in common; their 'last used' phase (Caple 2000:95). Therefore, since selective cleaning would uphold some representation of the paintings existence in the historic house, the discolored varnish and previous retouches could be considered just as important as the paintings original state. Therefore, as a conservator, it was justifiable to selectively clean the painting knowing that in doing so a part of the 'last used' phase of the painting would still be preserved. The areas that were not cleaned of varnish and secondary paint can be seen through comparisons of the two UV images in Appendix 1, and also represented in Imgs 34-35 when compared with Img 27.

Removal of surface dirt

Prior to varnish removal, the painting was cleaned using saliva. This was significant as its removal would ensure that while the painting would be selectively cleaned, the areas that were still covered with varnish would be free of surface dirt that had accumulated over the years.

Secondary paint removal

All secondary paint that was removed during the 2013/2014 cleaning treatment can be best observed in Img 34-35 compared with Img 27. As there is no general rule on how to handle later additions it was important to consider, like mentioned above, that alterations and additions are part of the painting's history (van der Goltz and Stoner 2012:498). That is why one of the largest overpaintings that was found throughout the sky was deliberated upon regarding its removal in collaboration with Asker Museum. As a result it was decided (von Ubisch 2013 email) that this overpanting, although it may have been performed by Otto Valstad and thereby reflecting his own personal taste, was removed from the painting. This overpainting was also ethically considered since historical additions might document or reproduce the original (van der Goltz and Stoner 2012:498), which in this case has been considered lost[72] and since it cannot be accurately confirmed that this retouching was indeed performed by Otto Valstad, only assumed. This is why extensive documentation has been set in place as interest of knowledge of what this

[72] Only a sketch of this painting has been identified by Raphael Sanzio () See Chapter 3 (Historical context chapter) for more information.

painting looked like prior to this 2013/2014 treatment may later prove to be significant (Appendix 1 Fig 1.1). This documentation was also important considering, the cleaning investigations regarding the intact layers of original paint found beneath the overpainted sky resulted in a clear difference in its portrayal (Imgs 64 & 65). Also, it was clearly observed in X-ray (Appendix 1 Fig 1.2) that the existence of intact original paint was present and that St. Mary's halo had been visibly painted over. Therefore, the removal of the overpainting proved to be more altering in its portrayal and understanding of the overall motif thereby considered ethically correct since it covered intact original paint (van de Goltz and Stoner 2012:499). Other secondary paint was also removed and considered accordingly, however, this painting was selectively cleaned in hopes to combat some of the ethical dilemmas regarding preservation of historical evidence of the paintings past.

Solubility parameters

This large overpainting found within the sky was removed specifically by the use of a paint stripper[73], isopropanol, isopropanol-benzylalcohol gel[74], and subsequently cleaned with white spirit while the varnish removal and removal of other secondary paint was performed using only isopropanol. Pembulen[75], was also used after the removal of the varnishes had taken place to aid in the removal of surface dirt that had accumulated under the previous varnish, however, this was only performed in selective areas. Please see Imgs 64-74 illustrating the varnish removal and secondary paint removal of this painting.

Each substance used in the removal of the large overpainting in the sky was used with a varied degree, however primarily the paint stripper was only used to break down the thickest areas of the overpaint, while the isopropanol-benzylalcohol gel and isopropanol were used once the original paint layers were visibly present to lessen the potential of original paint solubility.

The choice of materials used for the varnish removal were identified through the use of solubility parameters. This can be accomplished as once the chemical composition of a material is identified; solubility parameters can be taken into account and used to narrow down types of cleaning solvents for that material (Phenix, 1998:387). As the identification of the varnish was identified as being a low molecular weight resin due to its fluorescence under UV[76], then organic polar solvents became the first choice in removal testing (Phenix, 1998:387).

[73] Appendix 10
[74] See Appendix 10
[75] See Appendix 10
[76] Please see Original Materials chapter 4

A Teas chart is generally used to visually represent the different solvents that are soluble with relation to different substances. Img 78 provides the Teas chart, illustrating the locations of all of the solvents used to clean this painting of its varnishes and retouches. The chart also includes Stolow's (1957) approximate oil peak swelling position (Hedley 1993B:130-134). Therefore, as mentioned above, substances in close proximity Stolow's (1957) region were proceeded upon with care, in order to ensure no large interactions occurred to the underlying paint layers (Michalski 1990:99). The Teas chart was primarily only used as a guide (Phenix, 1998:387), as its visual presentation was easy to read. Therefore, in addition to this guide, personal experience, comprehension and skills were also taken into consideration during the partaking of the cleaning to ensure that the process were not visibly removing original paint (Caple, 2000:99).

Visual reintegration

After the selective cleaning had been completed, the painting was strip-lined and stretched to its new secondary support. Subsequently, the 2013/2014 visual integration began, by the addition of filler material, the performance of in-painting and the application of varnishes.

Filler material

During the cleaning, the majority of previous filler materials found already on the painting were retained (Imgs 65, 67, 69, 71 & 74). Therefore, only a few selected areas required additional filler material to be added to the painting. These were mainly in areas where either 1) previous filler material had been abraded slightly away during cleaning, 2) where secondary canvas was visible in larger losses in the original canvas, or 3) where it seemed essential in the understanding of the paintings motif. The choice of the material used for the filler was an adaptation of Berger's Beva 371 gesso recipe (Berger 1975:136). Instead of the usual calcium sulfate, these filler materials combined kaolin as suggested by Fuster-López (2012:591)[77]. This material was chosen mainly because of its application process and since its consistency can be manipulated for thicker or thinner application (Fuster-López 2012:591). Other materials, were considered however it was deduced that the solubility of this filler material, would render the 2013/2014 additions clearly detectable for future conservation treatments.[78] Please see Img 72 illustrating the addition of filler material of this painting.

[77] Also due to the unavailability of Beva 371 in solution, Lascaux 375 was used since it was considered equivalent. The recipe for the Filler material can also be found under Materials used.
[78] They would be rendered detectable, since the additions in the 2013/2014 treatment are soluble in aromatic solvents, while the previously used filler material were water soluble.

Retouching

The 2013/2014 in-paintings were placed only on filler material found on the painting, both newly added and previously found on the painting. These retouchings were carried out only on filler material, since covering of original material is strictly against ethical standards of conservation (AIC 1994; ECCO 2002). The materials used in the in-painting were Gouach egg tempera colors, by Talens[79]. Gouach was chosen due to its reversibility, handling properties, including its quick drying nature, ageing characteristics resistant to discoloration, and because of its aesthetic properties in imitating a wide variety of painting techniques (Kempski 2010:37).

The retouches applied to this painting were attempted to render the understanding of the painting motif visible *only* from afar, allowing the retouches to be visible up close (Imgs 69-73 compared with Img 75). This type of visible technique was performed since the painting is currently displayed above eye level in a distant corner of the main room in Otto Valstads home (Img--). From personal communication laid forth from Asker museum, it has been understood that this painting will always hang in its current position (Benterud 2013 personal communication) and this will be further stressed in the following chapter. Also, the highest measurement of light measured in a 9 month span in its current display position was 46 lux (Appendix 9). Therefore, this type of retouching seemed appropriate and justifiable, especially due to lack of skill and experience as a student.

The majority of viewers accept the losses found around the edges of a painting, and it is usually the parts in the central section of the painting that are the most disruptive (Friedländer 1942:334). Therefore more attention was paid to those retouches that were performed in the central areas of the motif. During the retouching process, as suggested by Digney-Peer et al (2012:612), reassessment was also continuously performed so balance was found throughout the painting. Additionally, the in-painting was produced by addressing the smaller lacunae first prior to venturing into more demanding areas (Digney-Peer et al 2012:610). Please see Imgs 69-73 & 75 illustrating the retouching of this painting.

With regards to choice of conservation in-painting materials, Gamblin retouching colors were also considered as a retouching material as they are stable and removable (Dunkerton 2010 pp 99-100; de la Rie et al. 2000). However, these were not chosen due to lack of time and the inability to test their handling capabilities.

[79] See Appendix 10.

Varnish

The 2013/2014 varnish was applied to the painting using four coats prior to in-painting and three coats after in-painting. The varnish chosen for this treatment was MS2A due to its reported appearance of being less glossy then varnishes such as Laropal A81, and Regalrez (van der Goltz et al 2012B:647). And to ensure further the dampening of the gloss in the varnish, an additional 1% cosmolloid 80h wax[80] was added to the MS2A stock solution. Furthermore, Kempski (2010:45) suggests the use of MS2A when using egg tempera retouching materials.

The MS2A was applied using a large flat brush in both horizontal and vertical movements. This particular varnish was primarily chosen since it is soluble in aromatic solvents (van der Goltz et al 2012B:646-647). This was considered the primary reason for its use on this particular painting, since MS2A's solubility would endorse the likelihood that in future treatment, distinction could be made in differentiating itself from the previous low molecular resin varnishes still currently found in selected areas of the painting. Yet to make things clearer, the location of the previous varnish can be observed in Appendix 1 Fig 1.4. Furthermore, the 1% cosmolloid 80h was added to the MS2A resin varnish to ensure that the painting's additional matt paspatout, discussed in the following section, would provide a more soft transition between the paspatout and the varnished painting.

Subsequently, during the retouching process all retouches were blotted with the MS2A stock varnish. This was performed since Gouach is fairly matt when applied to paintings and in order to ensure that their color corresponded with their surroundings, MS2A was applied lightly overtop to ensure compatibility (Kempski 2010:37). Also, this addition of blotting would likely assure that the retouches would not be removed during the final application of overlaying varnish layers.

Display

As mentioned earlier, the painting needed to fit its current decorative frame. Therefore, the new secondary polyester sailcloth added to the painting during the 2013/2014 strip-lining was similarly visible while mounted in the decorative frame (Img 75). However, as a conservation student, it was difficult to find justification and validation, especially in accordance to ethical professional guidelines (AIC 1994; ECCO 2002), with regards to retouching such large areas of bare canvas with secondary paint. Therefore, for display purposes it was suggested and also approved by Asker Museum (von Ubisch 2014

[80] See Appendix 10.

email) that a paspatout be added to the upper and lower parts of the motif in order to eliminate the visibility of the secondary canvas (Img 76).

8 Further Preservation:

Placement

The painting is hung on an exterior wall on the north east side of Otto Valstads Atelie (Img 79 & 80). This placement has been guaranteed that it will not change, since it is placed in Otto Valstads ‘’last used’’ placement (Benterud 2013 personal communication). However, in order to ascertain that it is not moved at any time in the future this conservation report will also emphasis the necessity of its placement. The paintings position should be upheld since primarily it is important for the sake of preserving Otto Valstads personal choice. Simultaneously, this painting has been conserved in its 2013/2014 treatment with regards to this placement as well. Therefore, if it is for any reason displayed in another location, the employee in charge (preferably a conservator) must read this conservation report thoroughly to certify that the painting and all of the treatment performed here benefits in its relocation.

Remounting

With regards to the paintings remounting, no special care will have to be placed on the painting since it will be hung using its previous mounting system. However, it is advised that the wall behind the painting be cleaned prior to mounting to free itself from any surface dirt. The structural additions that have been added to the painting during its 2013/2014 treatment (Img 77), will contribute to its further preservation, as these additions will contribute in the reduction of dirt, mold and condensation from forming on the painting as it is hung on an outer wall (Mecklenburg 2007:19-20; Hackney and Hedley 1981:64).). Therefore, the corresponding backing board and four corks should not be removed unless discussed with the author or another conservator. These components were added since a painting’s backside should avoid direct contact with an outer wall and will provide the paintings backside with an even amount of circulating airflow. The attachment of the backing board will also provide protection during transport, as a backside is more vulnerable to physical forces (Ramsay 2012:663).

Preventive actions that could be taken into consideration by Asker Museum

Preventive conservation is a part of a conservator’s duty (AIC 1994: ECCO 2002) to communicate how important it is to avoid, block and detect threats to museum objects rather than to merely treat objects after they have been damaged. This is because remedial conservation treatment on an artwork should be refrained from whenever possible, as they are in fact considered threats in themselves (CCI-ICC 2013).

Emphasis is therefore placed on ways of preventing damages and deterioration to a collection before they happen rather than allowing them to occur and thereafter fix them.

For that reason, this section would like to bring into focus that there is a list of 10 primary threats that are accepted and adhered to by conservators regarding the preventive conservation of museum objects. These are known as the ten agents of deterioration. They are 1) physical forces, 2) thieves and vandals, 3) dissociation, 4) fire, 5) water, 6) pests, 7) pollutants, 8) light, 9) incorrect temperature, and 10) incorrect relative humidity. This list as well as detailed information regarding each agent can be found on the Canadian Conservation Institute website for further inquiry (CCI-ICC 2013). Some of these have been understood, are difficult for Asker Museum to be put into place, as it is considered a historic house (having its own limitations in disrupting the buildings framework). However, their considerations are important to stress as their installment into a museums conservation strategy plan will often ensure the longevity of their cultural objects.

Therefore, if nothing else, it is recommended that a monitoring system regarding temperature and relative humidity (RH) of Otto Valstads ateliers, be put into place. This is recommended since fluctuating temperature and RH are influential in a paintings degradation processes (Thomson 1986:82-87). Not only, will monitoring aid in the understanding of the environment that the cultural heritage is displayed in, it will also ensure that future conservators remedially conserving the artworks in this room choose appropriate materials for their treatments.

For examples, some materials, like the consolidation medium MFC[81], used in this 2013/2014 treatment were chosen based on the nine months of readings taken of the Otto Valstad's atelie (Appendix 9), where the lowest registered temperature was 8.8°C. However, as this does not account for 3 months of an entire year, it is impossible to know, unless a monitoring plan is put into place at the museum, whether its choice was indeed suitable. This is a concern since MFC will malfunction if the temperature goes below 4°C, T_g (Hedlund and Johansson 2005:436). Therefore, monitoring would be beneficial in recognizing whether materials such as these are considered appropriate or not, so that they can be substituted if necessary. Simultaneously, monitoring will also help to ensure that other conservators do not use any materials based on assumptions as well. This is of importance since the materials that are inserted into a painting should be heavily considered and ideally have ever lasting stability qualities (Hansen-Bauer 167).

[81] Refer to Treatment Chapter 7

It has been understood (Benterud 2013 personal communication), that action has already been undertaken with regards to lowering the UV levels inside Otto Valstads Atelie. UV filters have been put on the room's main light source (the window directly beside this painting) and through the readings that have been taken these past nine months (Appendix 9), rather non-existent levels of UV have been registered. At least, when concerned with the location of this painting's current position. These low levels are even apparent in times when the curtains have been drawn up on the smaller window found within the room.

This painting also receives a low level of lux values, as a result of it being hung directly beside the room's main light source, in addition to the painting incorporating a rather protruding decorative frame. This is why low levels have been registered in the readings taken during the 9 months (Appendix 9). Needlesstosay, it should be understood that although this painting does not exceed the recommended levels of 200 lux (Thomson 1986:29), it does not warrant the lighting to be increased on the painting, since little light is ideal, both for the sake of the original pigments (Thomson 1986:2), but also since the painting has been retouched with this low level of lux in mind.

To conclude, the measurements from February - December 2013 illustrate both gradual and rapid fluctuations in temperature and RH (Appendix 9). Therefore, there is a concern when nine months of a full year suggest temperature levels ranging drastically from 8.8 - 32°C and RH levels from 27.1 – 64.2%RH. The recommended RH for paintings is 45-55% (Dixon 2012:672) and recommendations regarding reducing fungal growth are concerned with temperature levels reaching above 28°C (Petersen and Klocke 2012:694). Therefore, since it has been understood that this building, as a historic house, has its limitations in disrupting the buildings framework, it should be understood that merely minimizing the temperature and RH values, even just slightly, will improve the longevity of its cultural objects. Previous master students have laid forth recommendations concerning the removal of visitors wet outer wear prior to entering Otto Valstads Atelie, ensuring the doors and windows are properly closed when the Atelie is unoccupied, and also that any cracks should be filled within the buildings foundation, especially around the windows (Aasen 2011:59; Finholt 2011:56). If these have not been taken into consideration, then it is advised here that they should be, since they will minimize rapid fluctuations of temperature and RH in this room.

Further Preservation

Virgin and child with St Elizabeth and infant St John the Baptist, in a landscape – Asker Museum

9 Conclusion:

To conclude, this master thesis is a remedial conservation report of the painting *Maria og Elisabeth med barna i et landskap,* with its English title translated by the author to: *Virgin and child with St Elizabeth and infant St John the Baptist, in a landscape* from the Asker Museum collection. It combines all of the necessities of a conservation report by describing the paintings condition, and identifying its original and secondary materials prior to its 2013/2014 conservation treatment. It also includes information regarding further preservation actions that can be done to improve its longevity in its current environment.

Investigations undertaken on the painting were both non-invasive and invasive. They combined visual investigations, photo-analytical methods of analysis and XRF investigations, together with optical microscopy examinations and SEM-EDX analysis. For the 2013/2014 treatment, its structural requirements were far more addressed than its visual integration and cleaning treatment needs, as they were considered far more subjective. It has gone through a delining, including a removal of its previous mounting and its previous stretcher was switched out. A strip-lining has taken its place by giving the painting the support it's required along the edges and so it could be properly stretched to a new auxiliary support in a traditional manner. Only a selective cleaning took place by removing varnish layers on all of the figures and a large overpainting found in the sky of the motif. Visual reintegration also included an attachment of a paspatout on the paintings lower and upper halves to lessen personal opinion onto such large regions of bare secondary canvas. Preventive measures such as the addition of a backing board and four corks were supplemented in order to aid in the painting's longevity. These were added to the painting in hopes of providing better support during handling and reducing the likelihood of condensation of forming on its backside as it is hung on an outer wall.

Ethical considerations and deliberations were implemented with regards to all investigations and when concerned with 2013/2014 treatment options. Correspondingly, justification has been stated whenever original samples were extracted. It was treated with regards on being displayed in a historic house, implementing the importance of its 'last used phase' into the 2013/2014 treatment while simultaneously accessing the possibility of representing a copy of a lost artwork by Raphael Sanzio. Discussion with the museum was a main concern to ensure that conservation work applied to the paintings was not proceeded upon without the Museums own personal opinions, seeing that they understand Otto Valstad the best. Overall, its 2013/2014 treatment was proceeded upon so that it still has the possibility of being further studied with regards to its secondary materials. The investigations and treatment were properly docu-

mented and their still remains a substantial amount of secondary material that may or may not have been added by Otto Valstads himself.

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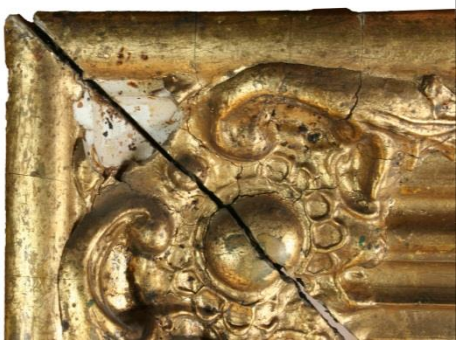
11 Images

Img 1 Decorative frame, front

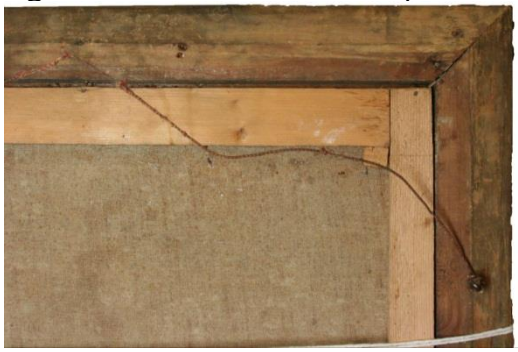
Img 2 Decorative frame, back

Img 3 Decorative frame, front, mid-section



Img 4 Decorative frame, front, split corner

Img 5 Decorative frame, back, lower corner



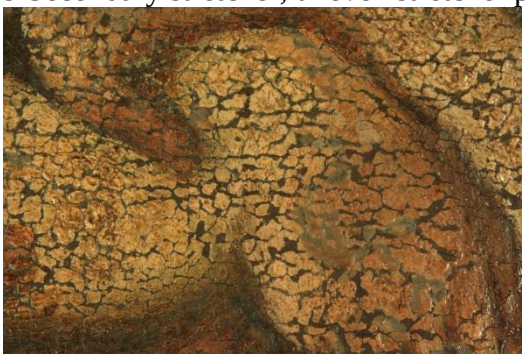
Img 6 Decorative frame, back, upper corner

Img 7 Secondary stretcher, ball point pen marks and

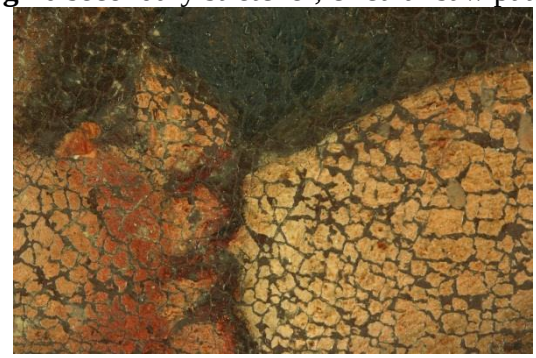
Img 8 Secondary stretcher joints

Img 9 Secondary stretcher, uneven stretcher plank

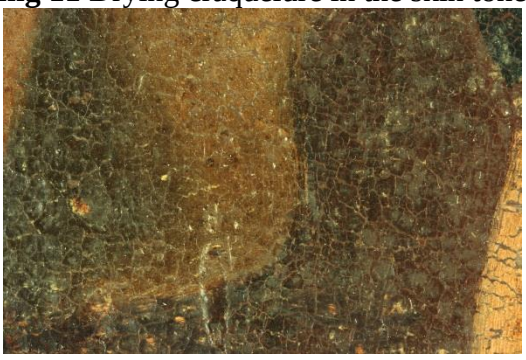
Img 10 secondary stretcher, circular saw pattern



Img 11 Drying craquelure in the skin tones



Img 12 Drying Craquelure in the skin tones

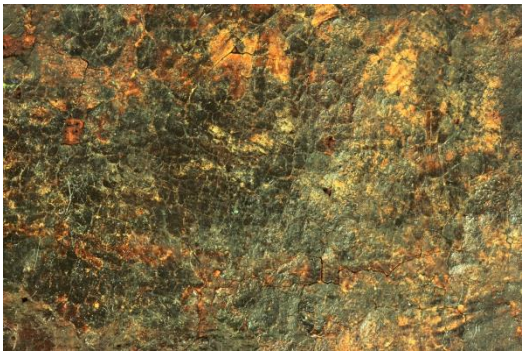


Img 13 St. Elizabeth cloak, green colored in its lower part

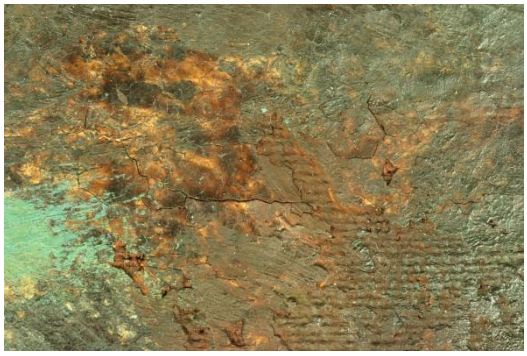
Img 14 Upper landscape, visible ground in the lighter areas

Images

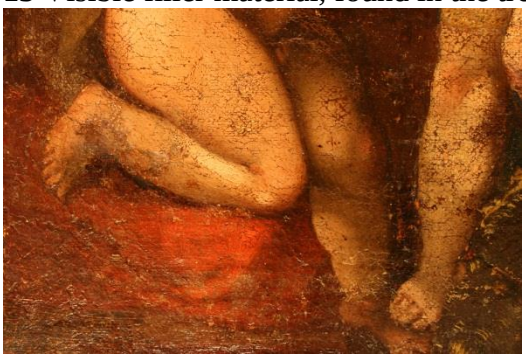
Virgin and child with St Elizabeth and infant St John the Baptist, in a landscape – Asker Museum



Img 15 Visible filler material, found in the tree 01

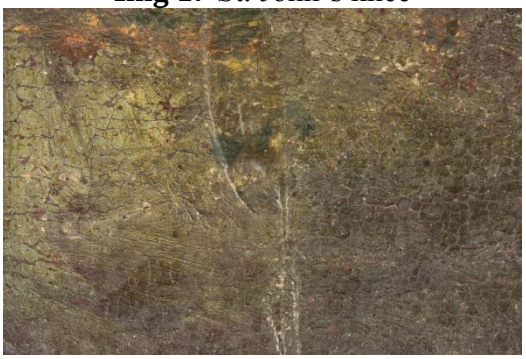


Img 16 Visible filler material, found in the tree 02

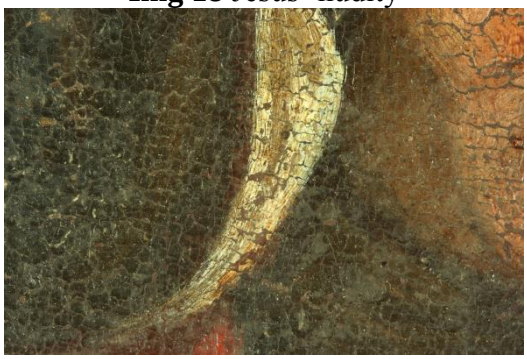


Img 17 St. John's knee

Img 18 Jesus' nudity

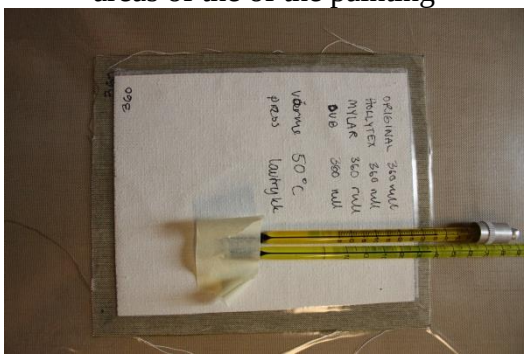


Img 19 Wax drip, found on the painting over the varnish



Img 20 Yellowing of the varnish seen in the white areas of the of the painting

Img 21 Reconstruction, trying to apply glue through mesh in hopes of creating nap bonding



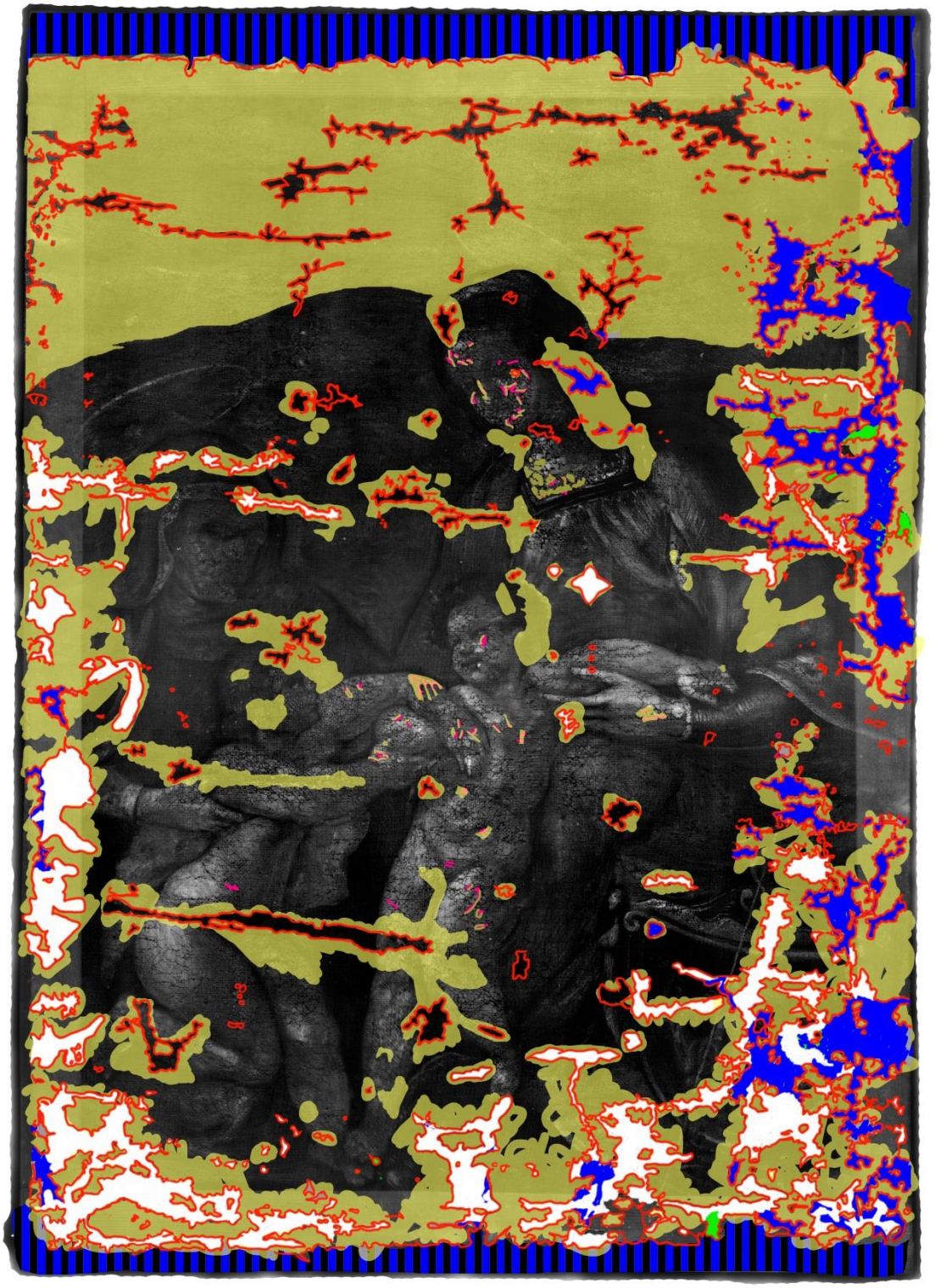
Img 22 Reconstructions, trying out different adhesives used in lining

Img 23 Transillumination image, prior to treatment

Img 24 Transillumination image, after treatment

Img 25 Raking light image of the painting, still attached to the lining

Img 26 Raking light image of the lining canvas



Img 27 Overview of loss, overpaint, retouches, and visible filler material, prior to treatment

Img 28 Areas of retouching, directly on canvas

Img 29 Losses located within the painting

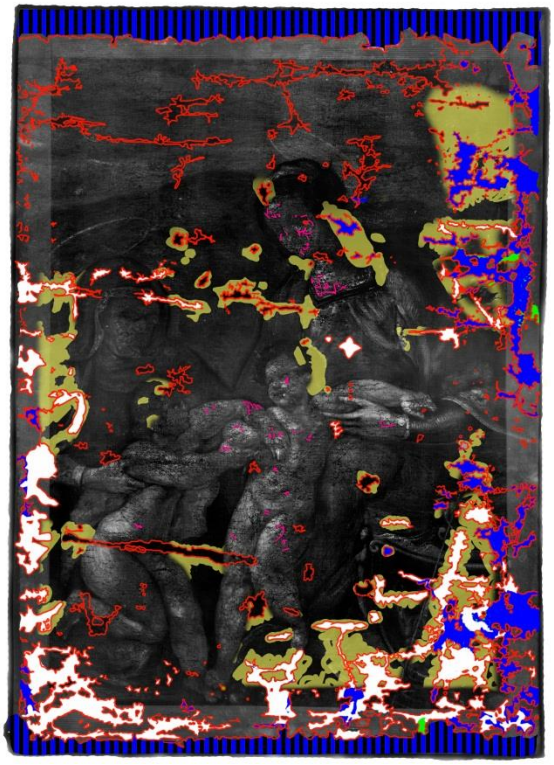
Img 30 Areas of bare original canvas, not covered by secondary paint

Img 31 Visible filler material prior to treatment (more were later found in the overpainted sky)

Img 32 Overpaint on original, prior to 2013/2014 treatment

Img 33 Overpaint on ground

Img 34 Overpaint on original, after 2013/2014 treatment



Img 35 Diagram illustrating removal of secondary paint in the 2013/2014 treatment

Img 36 The Virgin and Child with St Elizabeth and infant St John, Sketch, by Raphael (ca 1506) Royal Collection, Her majesty Queen Elizabeth, UK.

Img 37 Carnigiani Holy Family, By Raphael (1507) Alte Pinakothek, Munich, Germany.

Img 38 Small Holy Family, By Giolio Romano (1518), Le Louvre, Paris, France.

Img 39 The Holy Family or The Pearl, By Raphael or Guilio Romano (1519-1520), Prado Museum, Madrid.

Img 40 wear and tear along the edges of the original canvas 1

Img 41 wear and tear along the edges of the original canvas 2

Img 42 wear and tear along the edges of the original canvas 3

Img 43 wear and tear along the edges of the original canvas 4

Img 44 dead insects found after the removal of the painting from its decorative frame 1

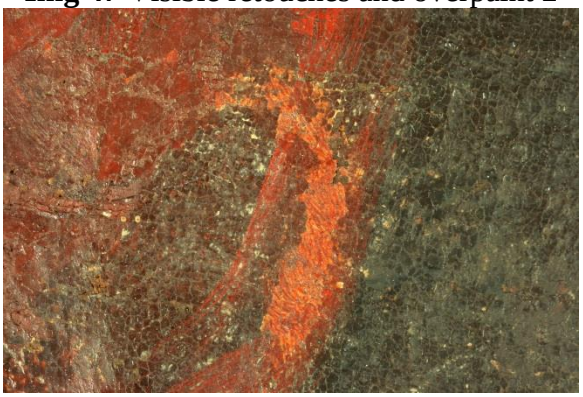
Img 45 dead insects found after the removal of the painting from its decorative frame 2

Images
Virgin and child with St Elizabeth and infant St John the Baptist, in a landscape – Asker Museum

Img 46 Visible retouches and overpaint 1

Img 47 Visible retouches and overpaint 2

Img 48 Retouches and visible filler material 1



Img 49 Retouches and visible filler material 2

Img 50 facing with Lascaux 375 and white spirit

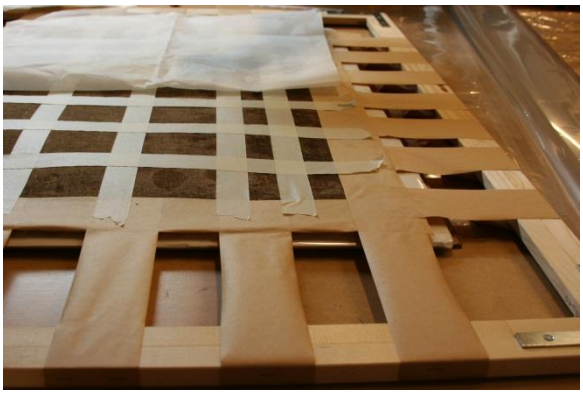
Img 51 Facing with Sturgeon glue

Img 52 Mechanically Delining 1

Img 53 Mechanically Delining 2

Img 54 Temporary mounting

Img 55 the addition of brown craft paper for the temporary mounting

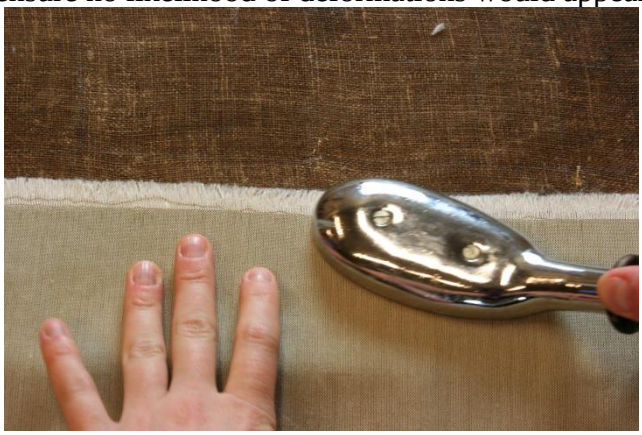


Img 56 The preparations for lining glue removal with Klucel J mixture

Img 57 Removal of lining glue using klucel J mixture

Img 58 Constant pressure was put on the canvas to ensure no likelihood of deformations would appear

Img 59 Stainless steel staples used using the stretcher with a piece of blotting paper below

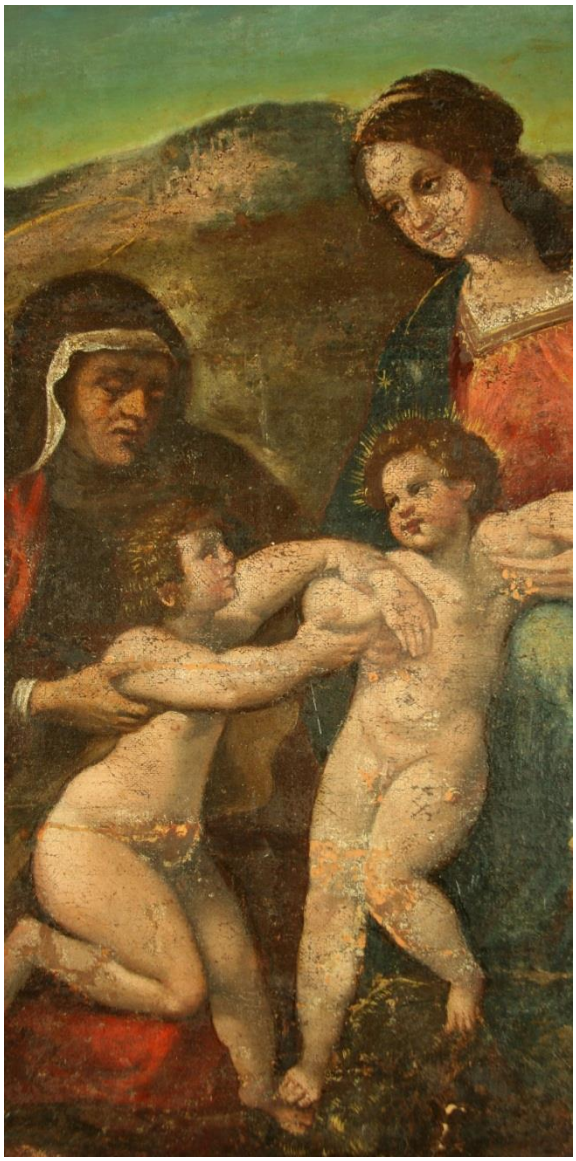


Img 60 Striplining with BEVA 371 film 1

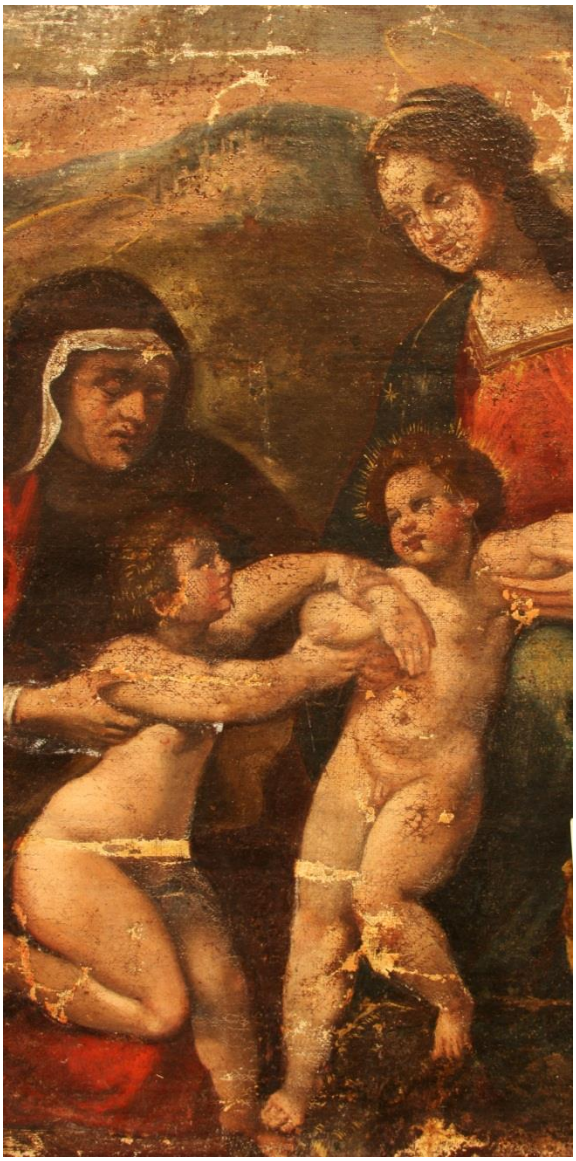
Img 61 Striplining with BEVA 371 film 2

Img 62 Striplining with BEVA 371 film 3

Img 63 Striplining with BEVA 371 film 4

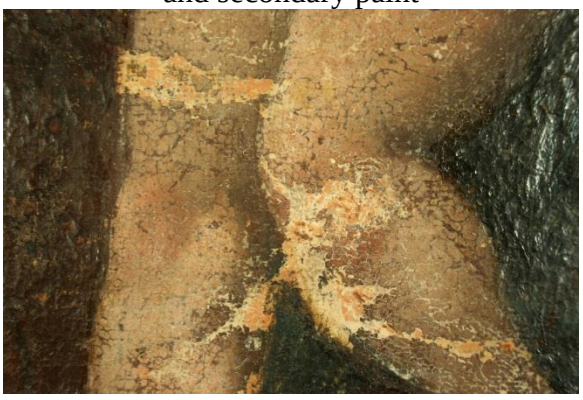


Img 64 Figures cleaned of varnish



Img 65 All figures, and sky cleaned of varnish and secondary paint

Img 66 Previous overpainting, prior to cleaning



Img 67 After the removal of the over painting

Images

Virgin and child with St Elizabeth and infant St John the Baptist, in a landscape – Asker Museum

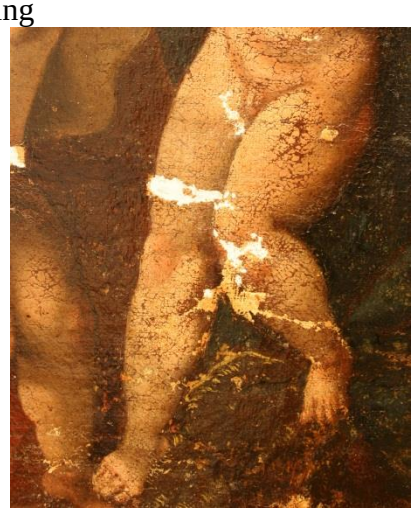
Img 68 Prior to varnish and secondary paint removal

Img 68 After removal of varnish and secondary paint

Img 69 After removal of the varnish and secondary paint, prior to retouching

Img 70 After retouching

Img 71 After removal of the varnish and secondary paint



Img 72 the addition of filler material in selective areas

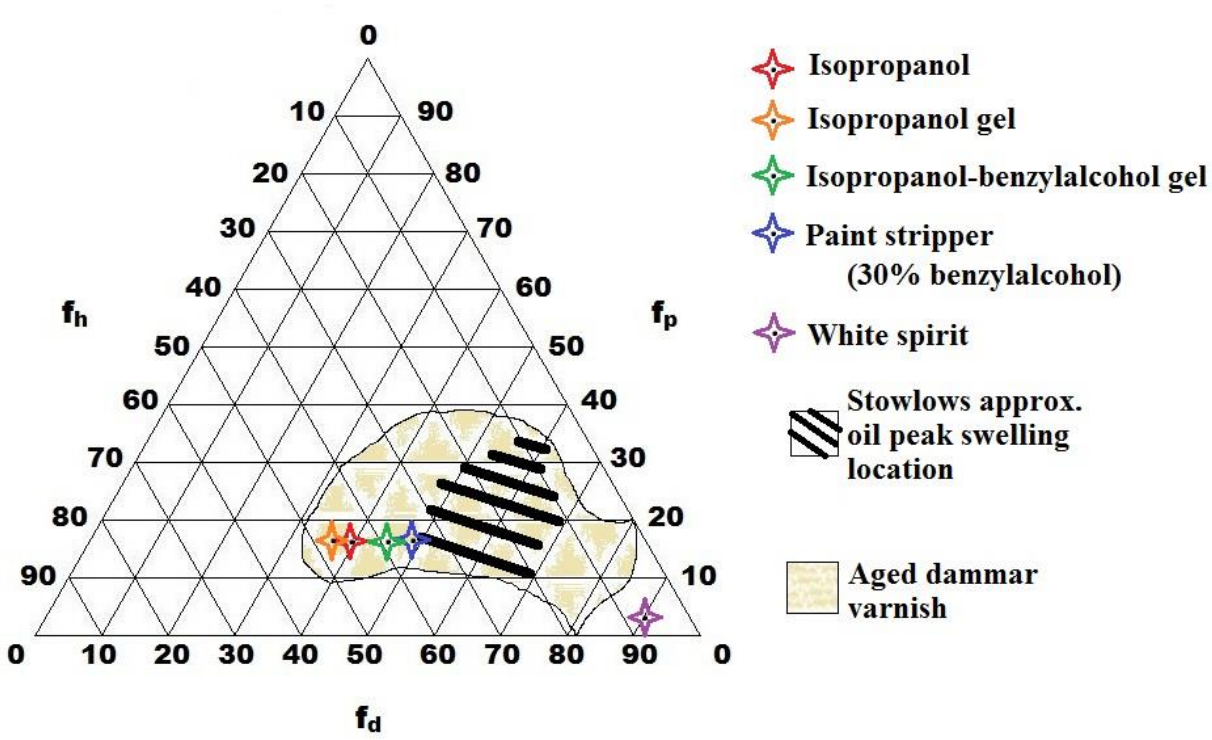
Img 73 After retouching

Img 74 The selectively cleaned painting, performed in the 2013/2014 treatment

Img 75 Image after retouching mounted in its frame, notice the bare secondary canvas.

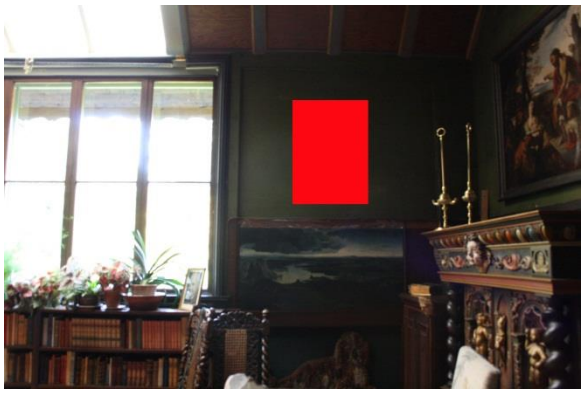
Img 76 Front of painting after treatment

Img 77 Back of the painting after treatment



Img 78 The Teas Chart

Img 79 Placement of this painting in Otto Valstads Atelie 1



Img 80 Placement of this painting in Otto Valstads Atelie 2

Appendix 1 Photo-analytical methods of analysis:

The Infrared-1, Infrared-2 (IR), false color infrared-1, false color infrared-2 (FCIR), ultraviolet (UV) and a color image (COL) taken during this investigation process were taken using a multispectral digital imaging camera (Artist Camera) developed by Art Innovation specifically designed for the inspection of artworks. The X-ray was taken using a portable CR^{x}25P computed radiography scanner from GE, set to 40kV, 0.6mA and 100s exposure time. All of these imaging techniques were taken of four parts of the painting, and later stitched together using Adobe Photoshop.

1. **COL[82] (Fig 1.1):** The colored image was taken of the painting upon its arrival to the atelier at the University of Oslo, Conservation program. This colored image is illustrated as the paintings before picture and was taken in visible light.
2. **IR[83] (Fig 1.5 & 1.6):** IR imaging was performed on the painting mainly to see if any eventual under-drawings were present. Infrared regions are of lower wavelengths than regular light (Newman 2000:171) and many pigments do not absorb as many IR rays making them transparent in these imaging modes. Transparent paint will therefore reveal underlying drawings that were created using pigments that absorb a lot more, like carbon black for instance (Matteini and Mazzeo 2009:51). However, since this painting is painted on a colored ground, it became clear that if an underdrawing was present, it would not be rendered visible through IR1 and IR2 since colored grounds have the potential of being made of materials that absorb just as much IR as the pigment used in the underdrawing (Matteini and Mazzeo 2009:51). Therefore, IR imaging had only the capability of aiding in the identification of secondary materials found in the painting.
3. **FCIR[84] (Fig 1.7 & 1.8):** FCIR imaging combines the IR rays and visible light rays (Moon et al 1992:42). When comparing these photo-analytical images with the original painting in visible light, pigments that are similar in visible light may appear completely different in FCIR imaging (Matteini and Mazzeo 2009:67). This method of analysis is best suited in differentiating similar colored pigments; yet, Moon (et al 1992) have experimented in identifying the corresponding color of certain pigments in FCIR with the use of modern tube paints. Therefore, their work has been used in some

[82] **Visible light:** wavelength 400 – 700 nm.
[83] **IR-1:** wavelength 700 – 1000 nm . **IR-2:** wavelength 1000 – 1100 nm.
[84] **FCIR-1:** combines wavelength IR 700 – 1000 nm and visible light 400 – 700 nm. **FCIR-2:** combined wavelength IR 1000 – 1100 nm and visible light 400 – 700 nm

instances of this thesis, to help support the probability of certain pigments having been used within this painting.

4. **UV[85] (1.3 & 1.4):** Only UV fluorescence, and not UV reflectance was taken of this painting. For UV fluorescence, the process involves irradiating the painting or sample of interest with UV rays (Stuart 2007:75). What is seen is not UV but rather its rays being reflected from the surface (Macbeth 2012:294). This occurs under UV illumination and not under visible light since molecules absorb radiation and form an excited state (Stuart 2007:75). Pigment identification can be provided by UV fluorescence as well as the presence of aged varnishes (Macbeth 2012:294). Slightly opaque and characteristically green coatings are the two identifiers of natural aged resins under fluorescence (Macbeth 2012:294). One UV image was taken prior to varnish removal (img 1.3), while another was taken after selective cleaning had been performed (img1.4).
5. **X-RAY[86] (Fig 1.2):** X-radiographs short-wavelengths and high-energy penetrate all materials in a painting (Stuart 2007:78). X-radiographs provide information of certain pigments and attributes linked to a paintings support system since the x-ray absorption is heavily dependent on the atomic weight and density of the employed materials (Stuart 2007:79). X-ray can also provide regarding the identification of filler material as its density could be incongruent with its surroundings in the painting (Stuart 2007:79).

[85] **UV:** wavelength 300 – 400 nm
[86] **X-ray**: wavelength 10 – 10^{-2} nm

Appendix 1
Photoanalytical methods of analysis

Fig 1.1 Color image, prior to investigations and treatment

Fig 1.2 X-ray of the image, prior to investigations and treatment

Fig 1.3 UV image, prior to investigations and treatment

Fig 1.4 UV image, after the 2013/2014 cleaning treatment

Fig 1.5 IR-1 image, prior to the investigations and treatment

Fig 1.6 IR-2 image, prior to the investigations and treatment

Fig 1.7 FCIR-1 image, prior to the investigations and treatment

Fig 1.8 FCIR-2 image, prior to the investigations and treatment

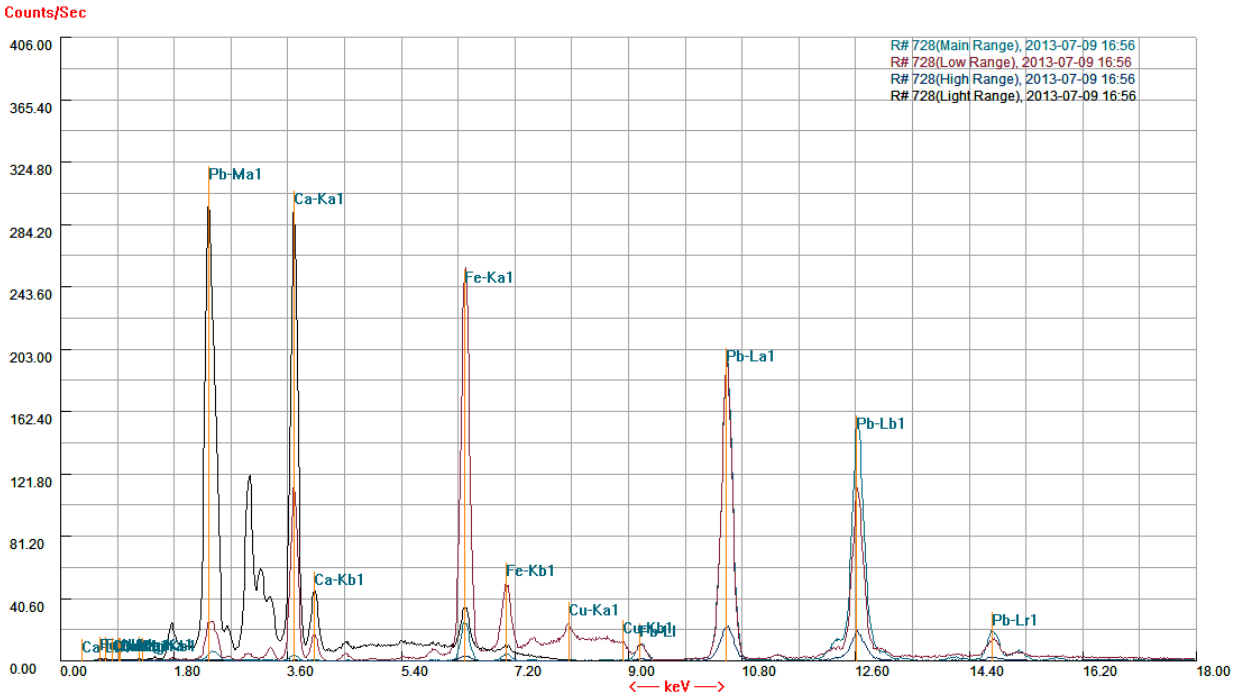
Appendix 2 XRF

X-ray Fluorescence (XRF) is a method useful for pigment identification. It is highly used due to its non-invasive technique. This type of analysis is performed using a handheld XRF device that is pointed at the painting facilitating its ability to identify heavy elements found in any desired region chosen (approx. 3 mm in size). This is made possible since the energy that this device creates fluoresces back from the painting to the device and is recorded in a spectrum (Stuart 2007:236). However, since XRF instrumentation cannot detect elements with lower atomic weight then magnesium, it is not easy to localize organic pigments, only inorganic, with this device. Furthermore, as it the device analyzes several layers found in one region, elements originating only in one particular layer cannot be identified (Stuart 2007:41). Therefore it is up to the conservator to analyze and interpret all the data retrieved from the analysis and estimate in which layer the elements are likely to be found in.

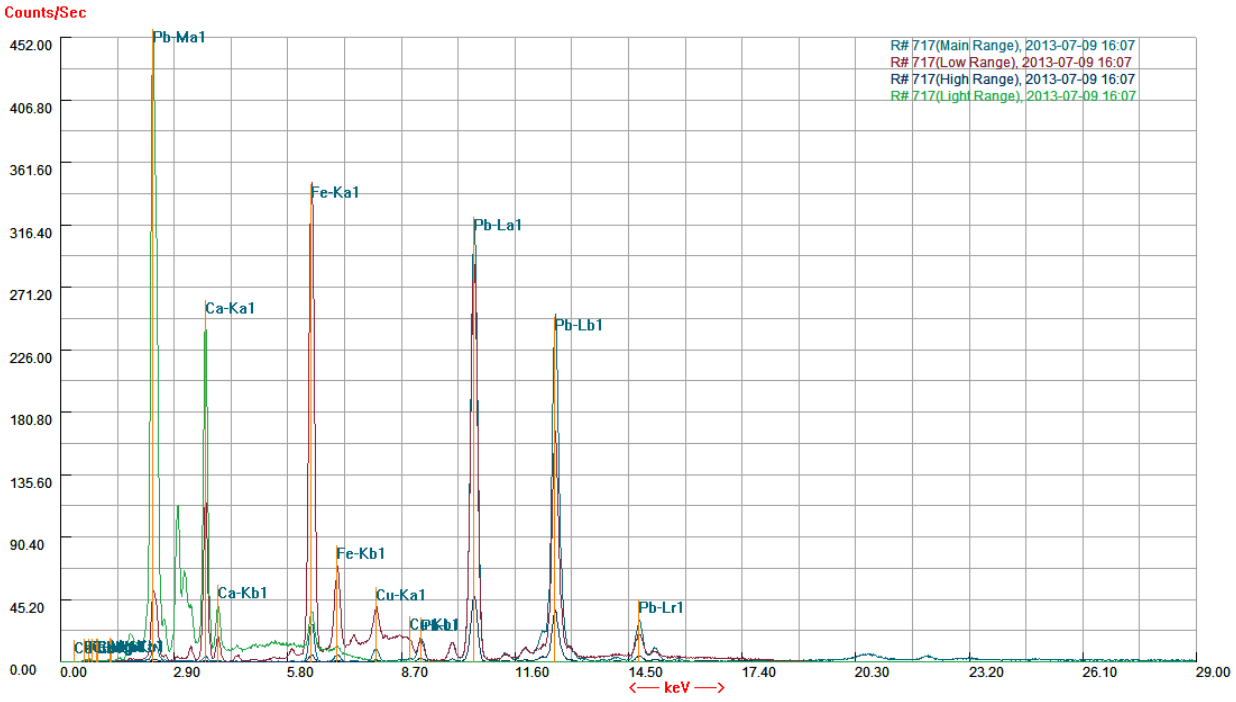
Fig 2.1 XRF locations

A – no. 728	K - no. 718
B – no. 717	L – no. 729
C – no. 1049	M –no. 1055
D – no. 1024	N – no. 1050
E – no. 1026	O – no. 1051
F – no. 1029	P – no. 1052
G – no. 726	Q – no. 1053
H – no. 722	R – no. 721
I – no. 723	S – no. 716
J – no. 719	T – no. 1056

Appendix 3
XRF Analysis

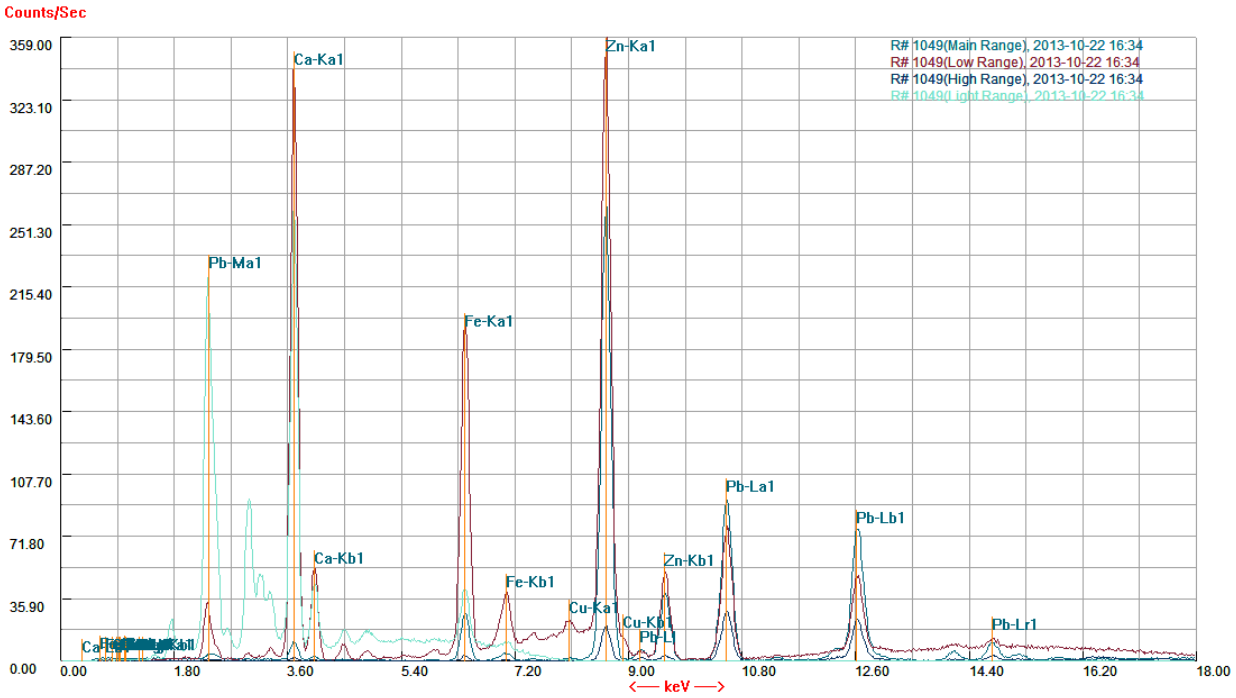


No. 728 - St. Mary's cloak (Appendix 8 no.201) Pb, Ca, Fe, & Cu

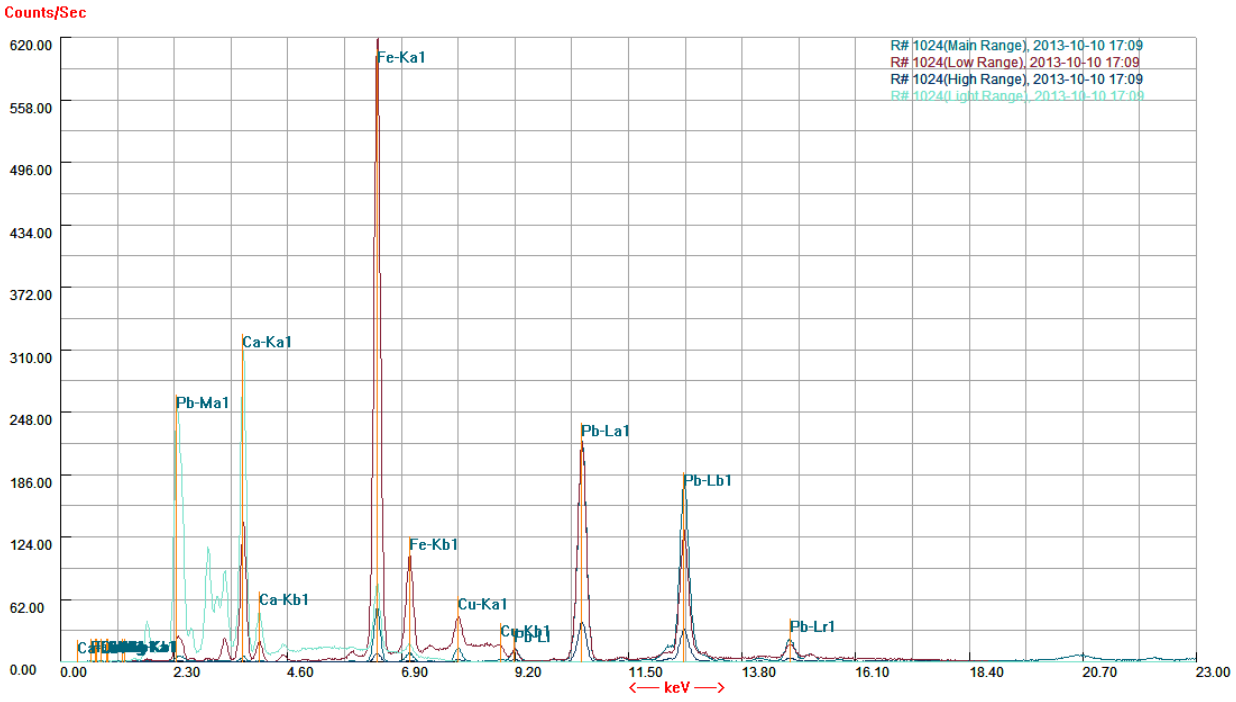


No. 717 - The upper landscape (Appendix 8 no. 202) Pb, Ca, Fe & Cu

Appendix 3
XRF Analysis

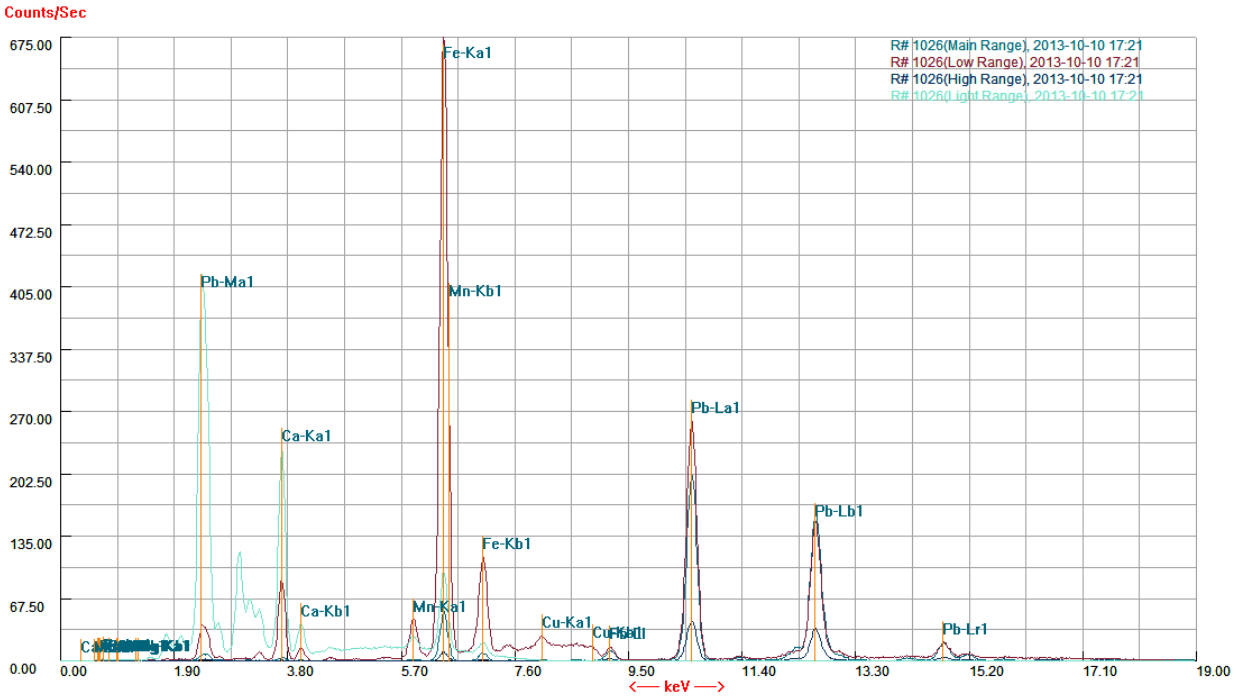


No 1049 - The sky (Appendix 8 no. 203) Pb, Ca, Fe, Cu & Zn



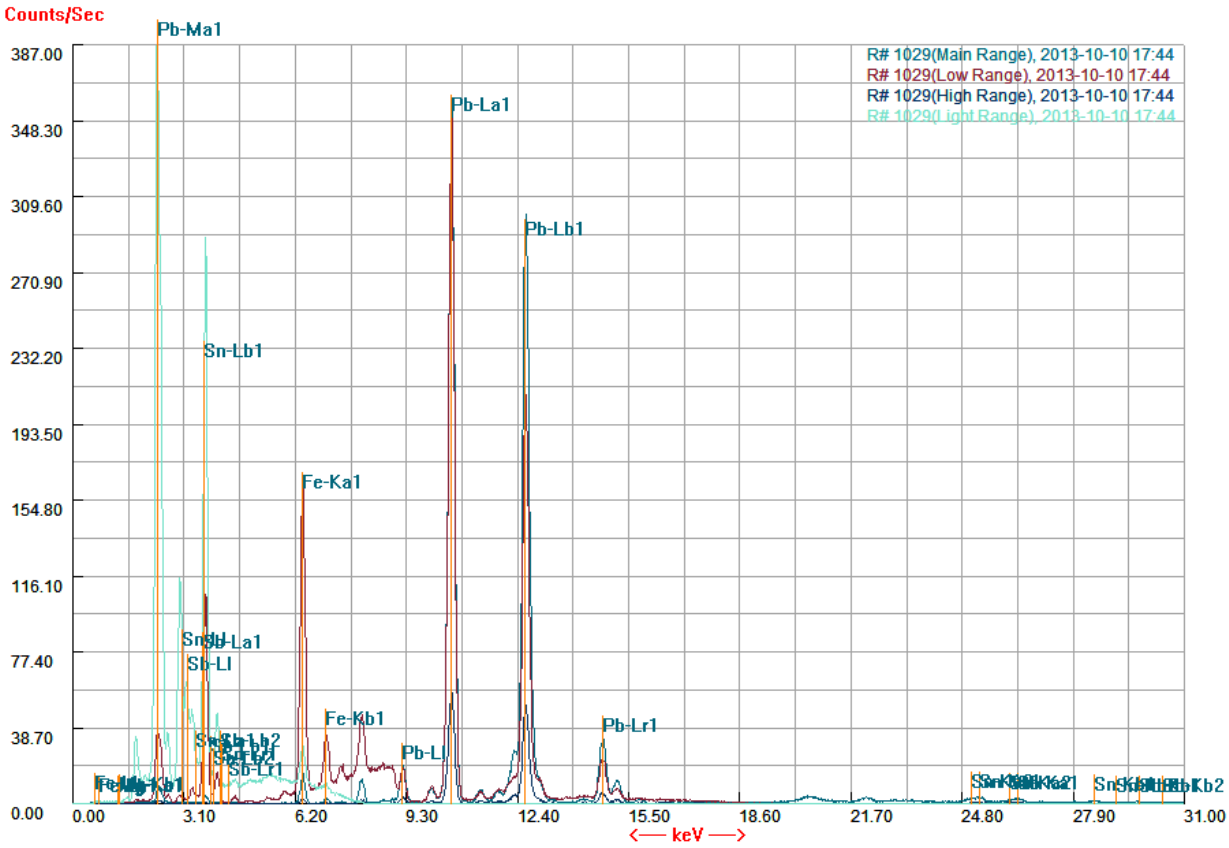
No. 1024 - The lower landscape (Appendix 8 no.301) Pb, Ca, Cu & Fe

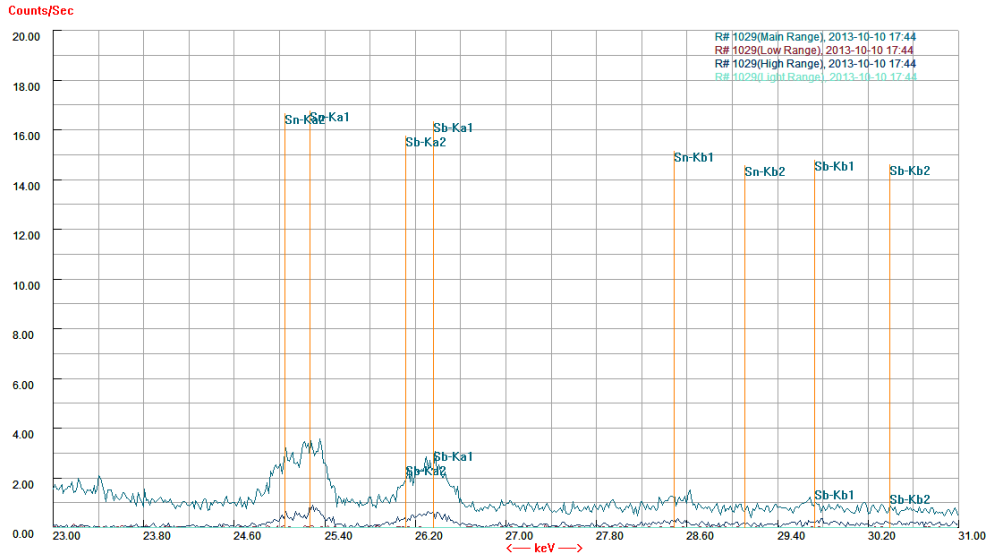
Appendix 3
XRF Analysis



No. 1026 - St. Elizabeth's garment (Appendix 8 no.302) Pb, Ca, Mn, Fe, & Cu

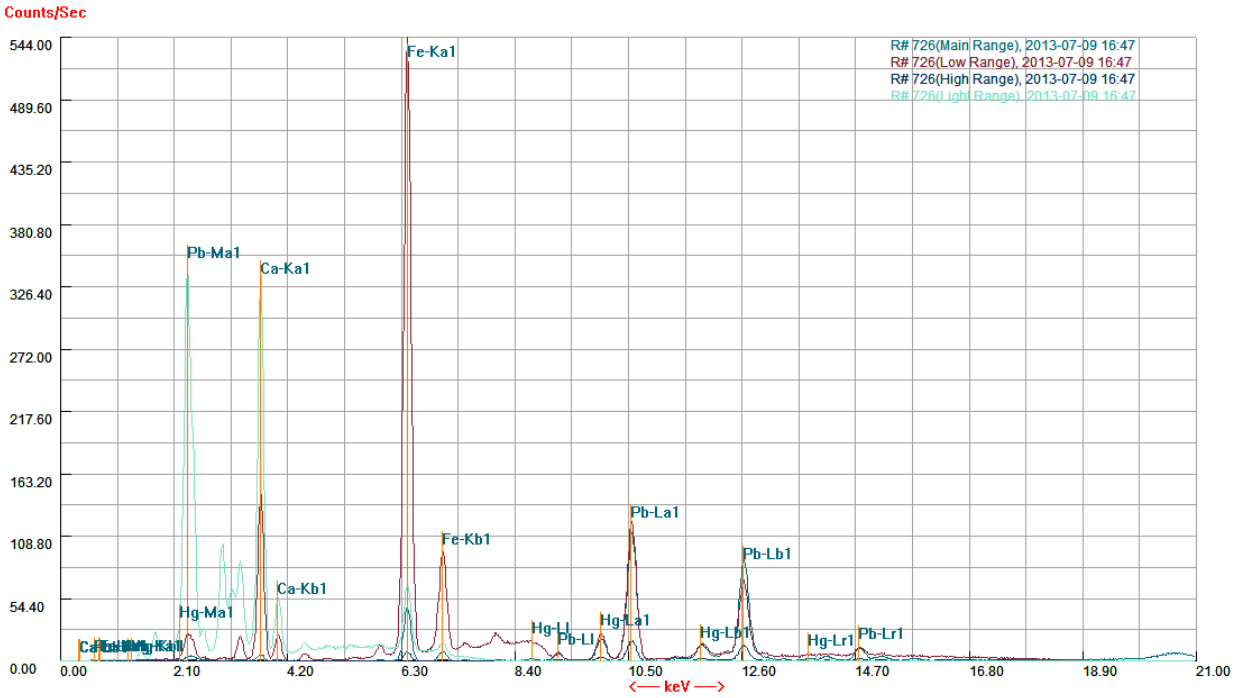
Appendix 3
XRF Analysis



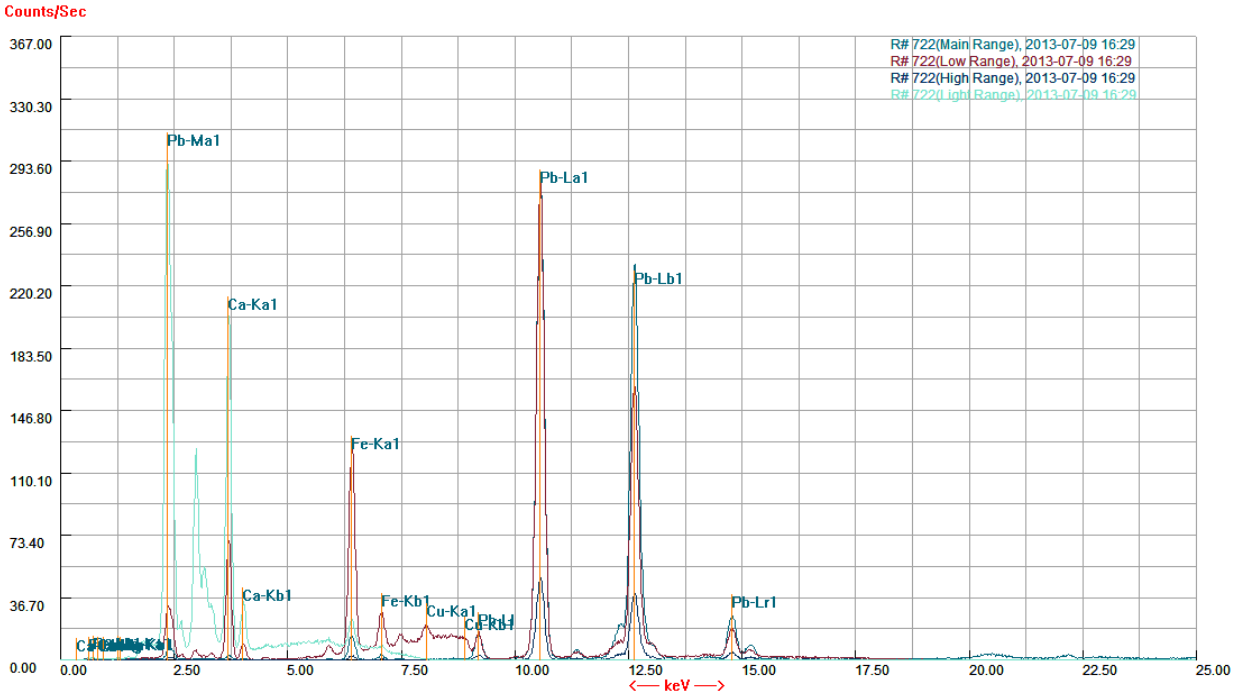


No 1029 - St. Elizabeth's halo (Appendix 8 no. 401) Sn, Sb, Fe, & Pb

Appendix 3
XRF Analysis

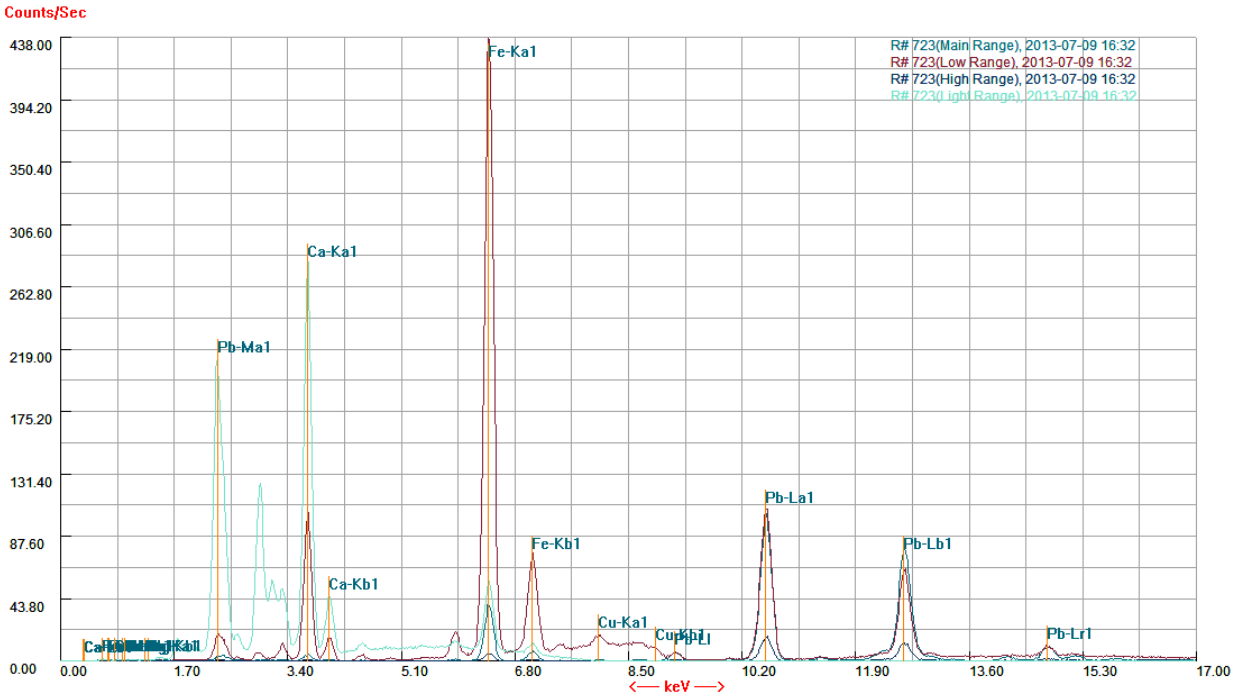


No. 716 - St Mary's dress (Appendix 8 no. 501) Pb, Ca, Fe, & Hg

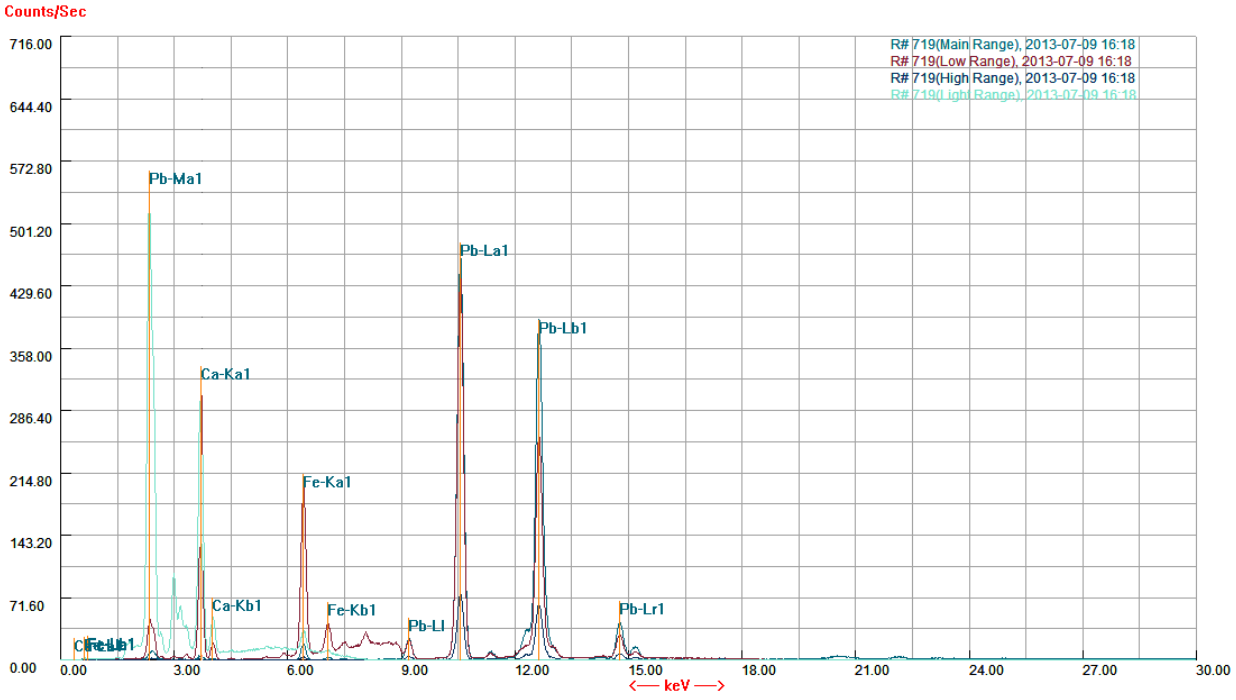


No. 722 - St. Elizabeth's cloak (Appendix 8 no. 502) Pb, Ca, Fe, & Cu

Appendix 3
XRF Analysis

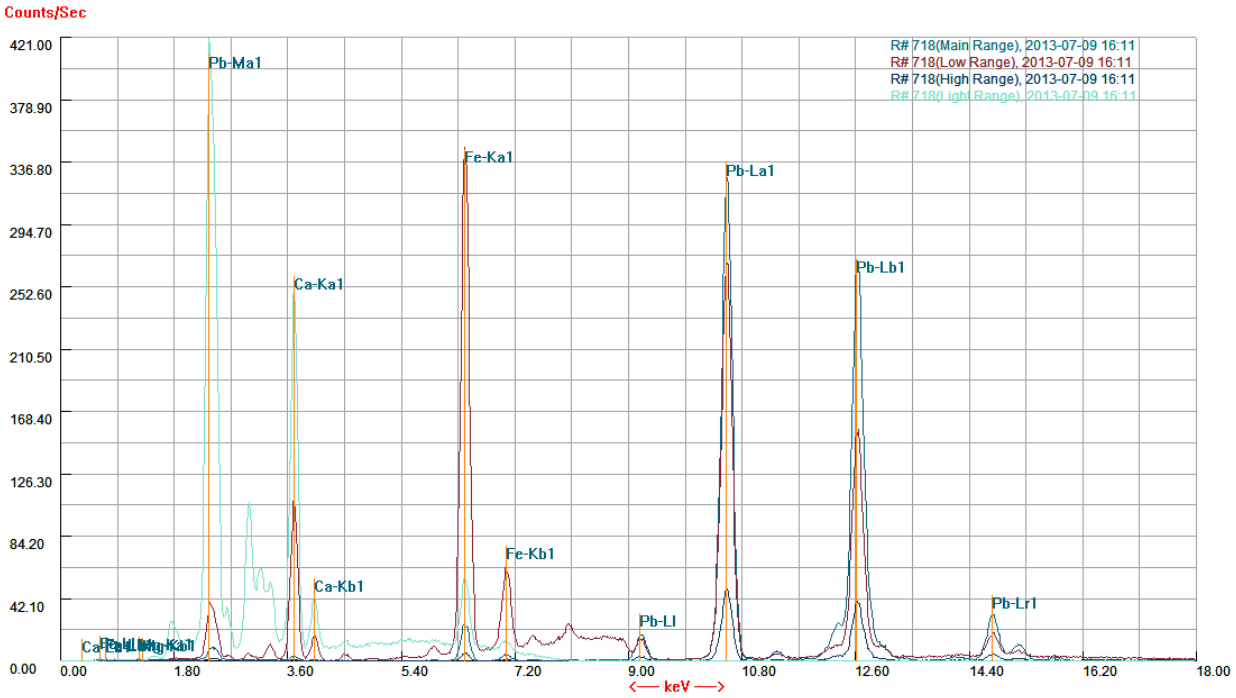


No. 723 - St. Elizabeth's cloak (Appendix 8 no. 502) Pb, Ca, Fe, & Cu

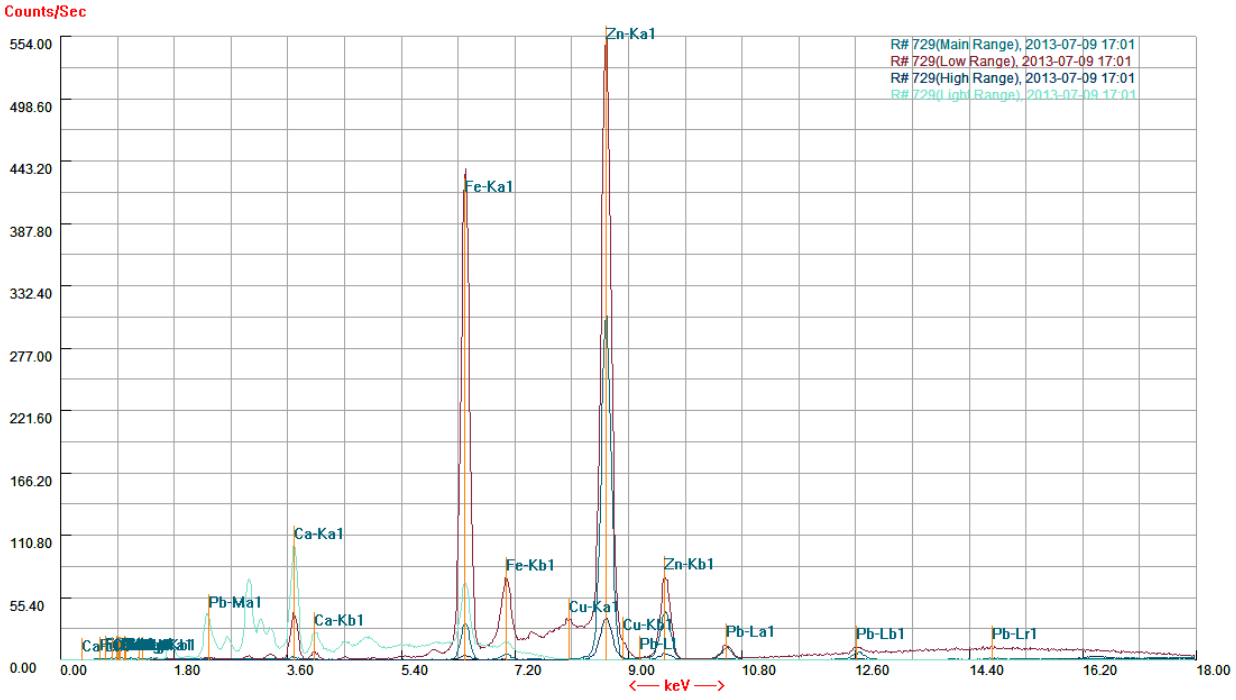


No 719 - Jesus' leg (Appendix 8 no. 901) Pb, Ca, & Fe

Appendix 3
XRF Analysis

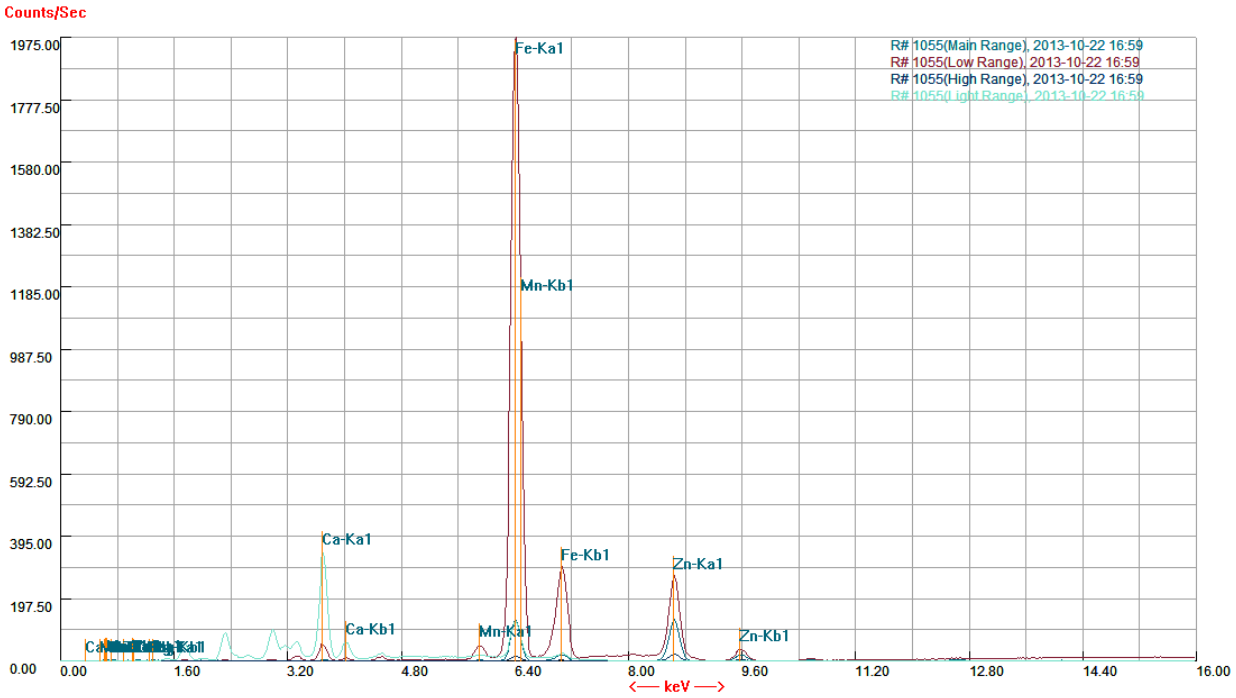


No 718 - St. John the Baptist's arm (Appendix 8 no. 901) Pb, Ca, & Fe

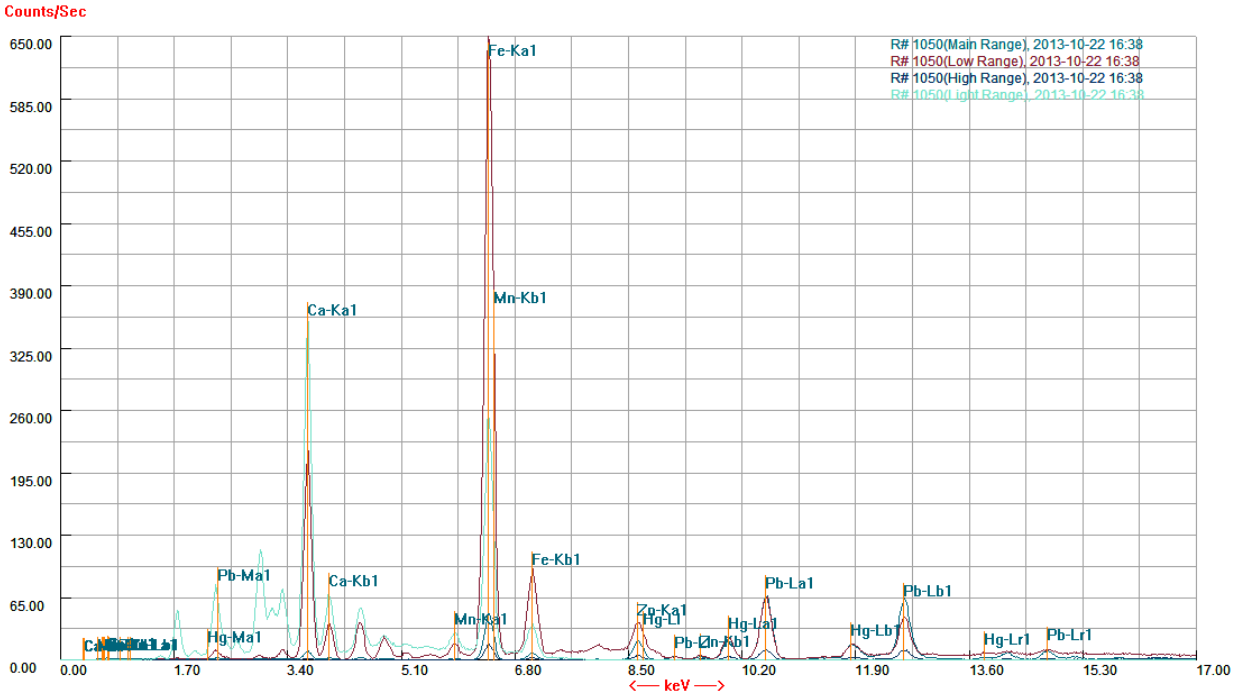


No 729 - Secondary blue on secondary canvas, Pb, CA, Fe, Zn & Cu

Appendix 3
XRF Analysis

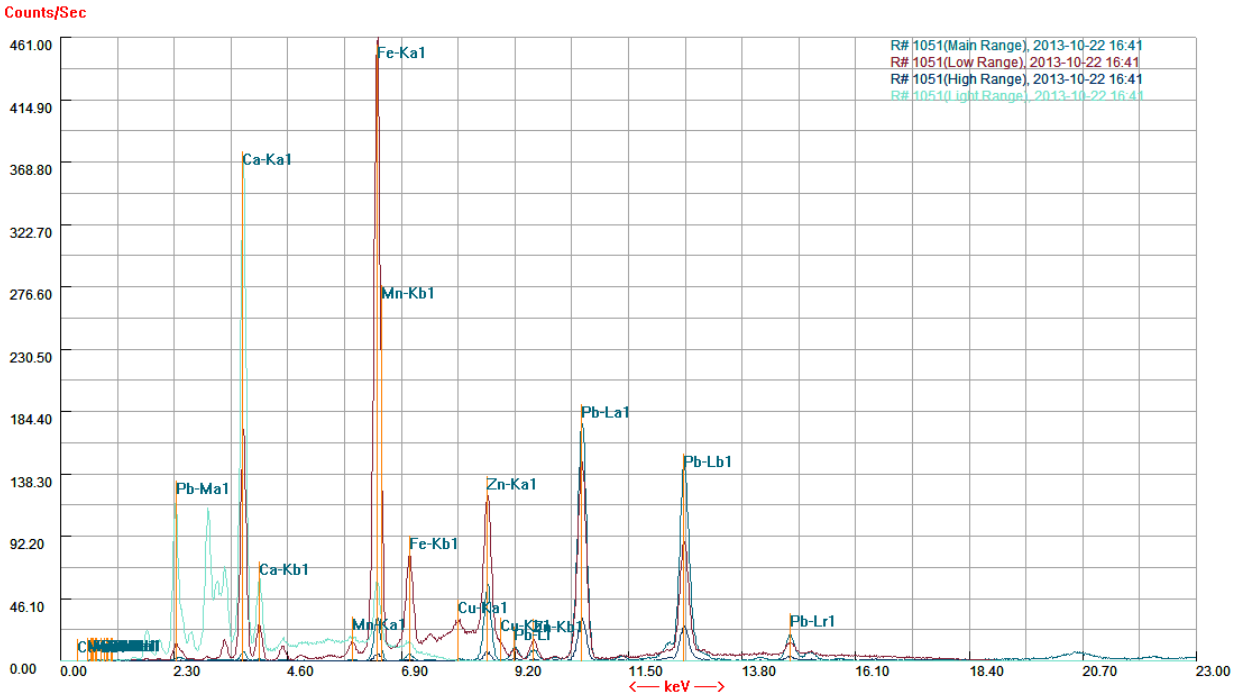


no. 1055 - Secondary brown on secondary canvas, Ca, Fe, Mn & Zn

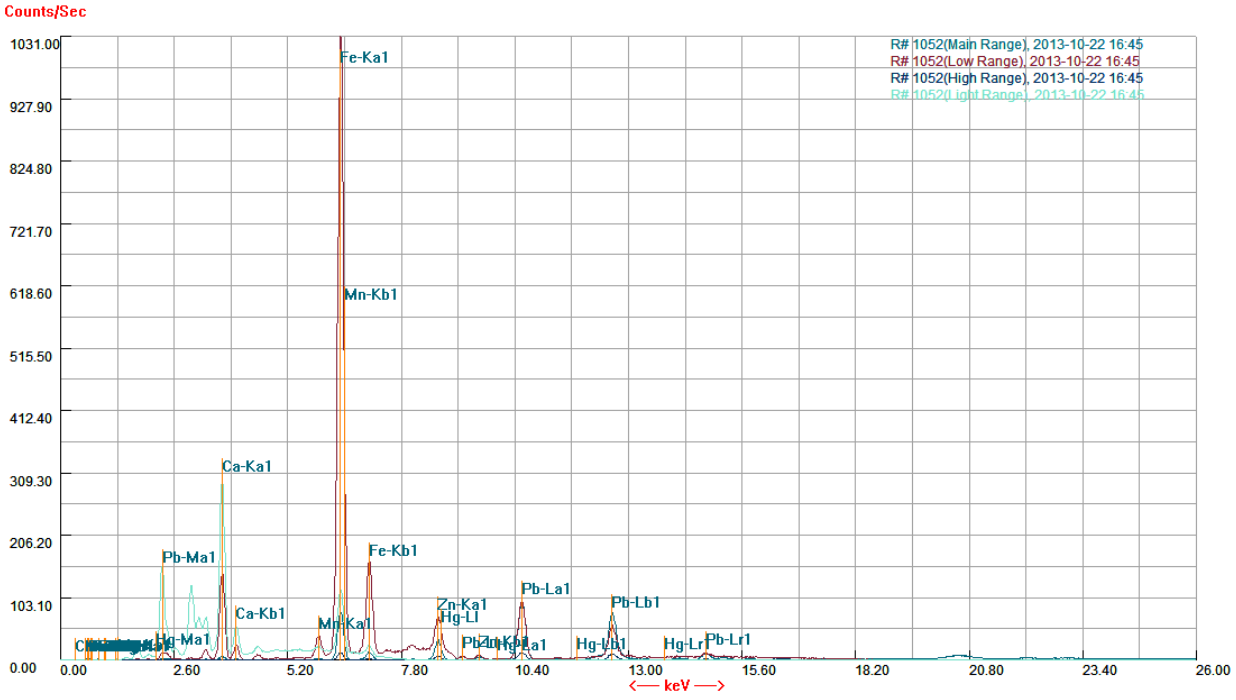


No. 1050 – Secondary red, Pb, Ca, Mn, Fe Zn, & Hg

Appendix 3
XRF Analysis

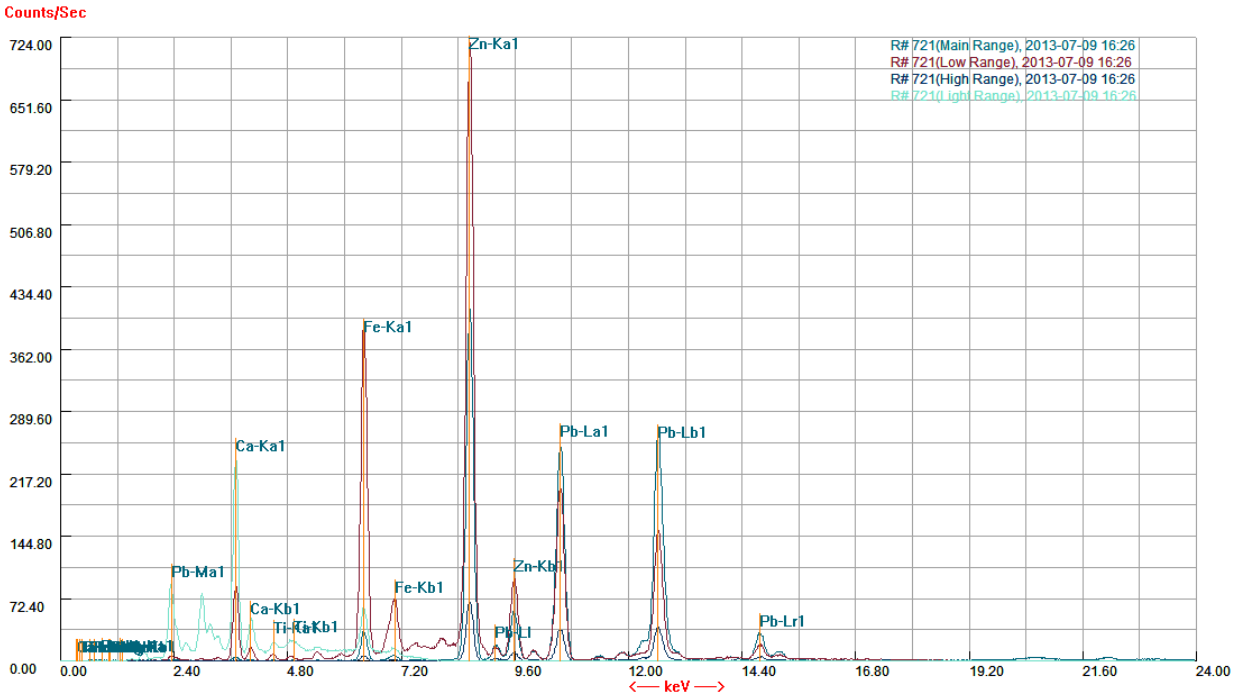


No 1051 - Secondary blue, Pb, Ca, Mn, Fe, Zn & Cu

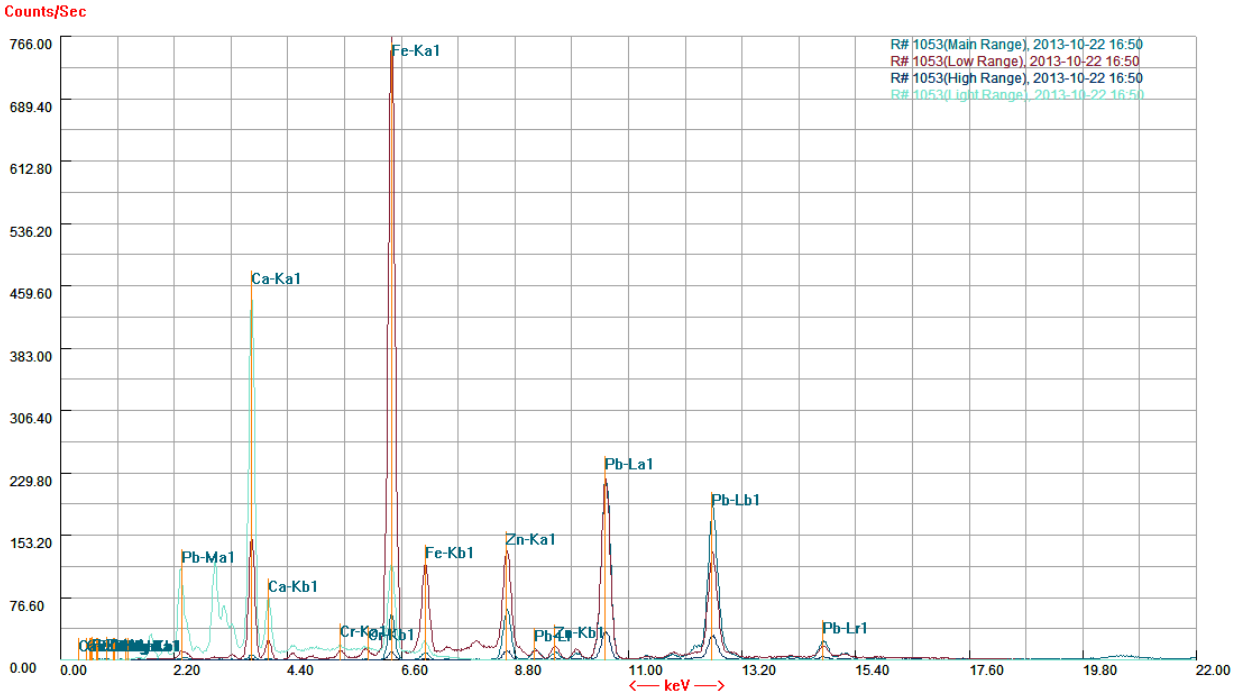


No 1052 – Secondary brown, Pb, Ca, Mn, Fe, Zn, & Hg

Appendix 3
XRF Analysis

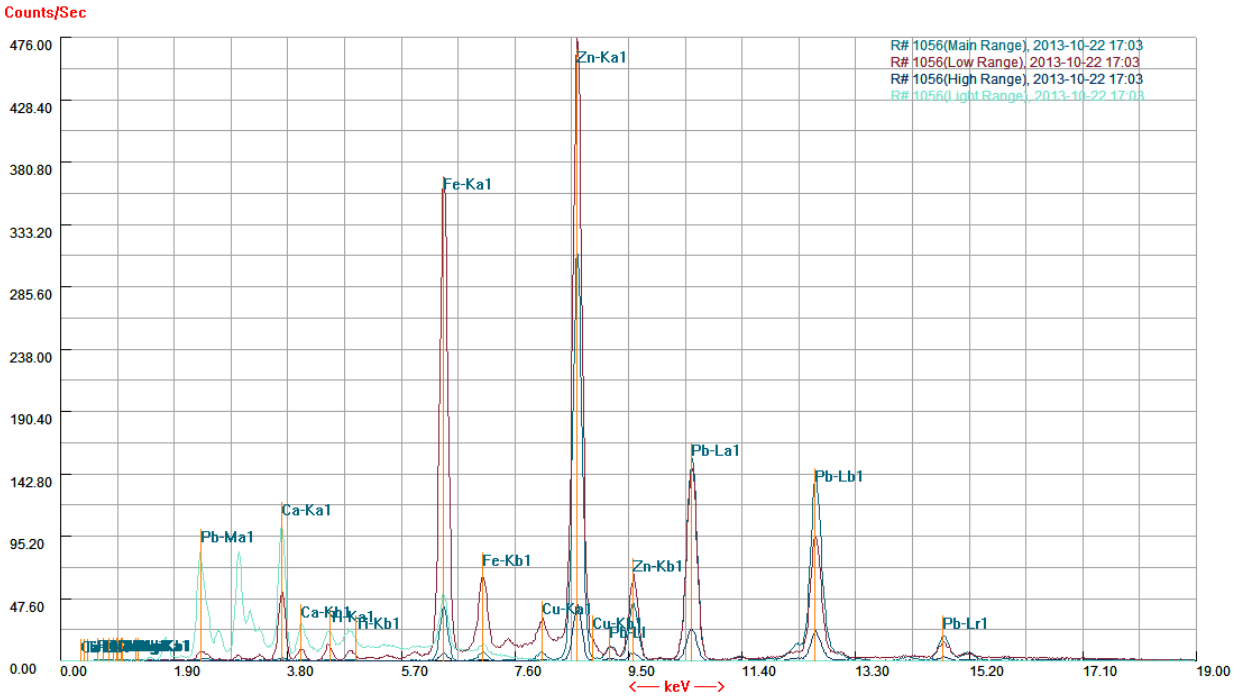


No 721 – Secondary skin tone, Pb, Ca, Fe, Zn, & Ti

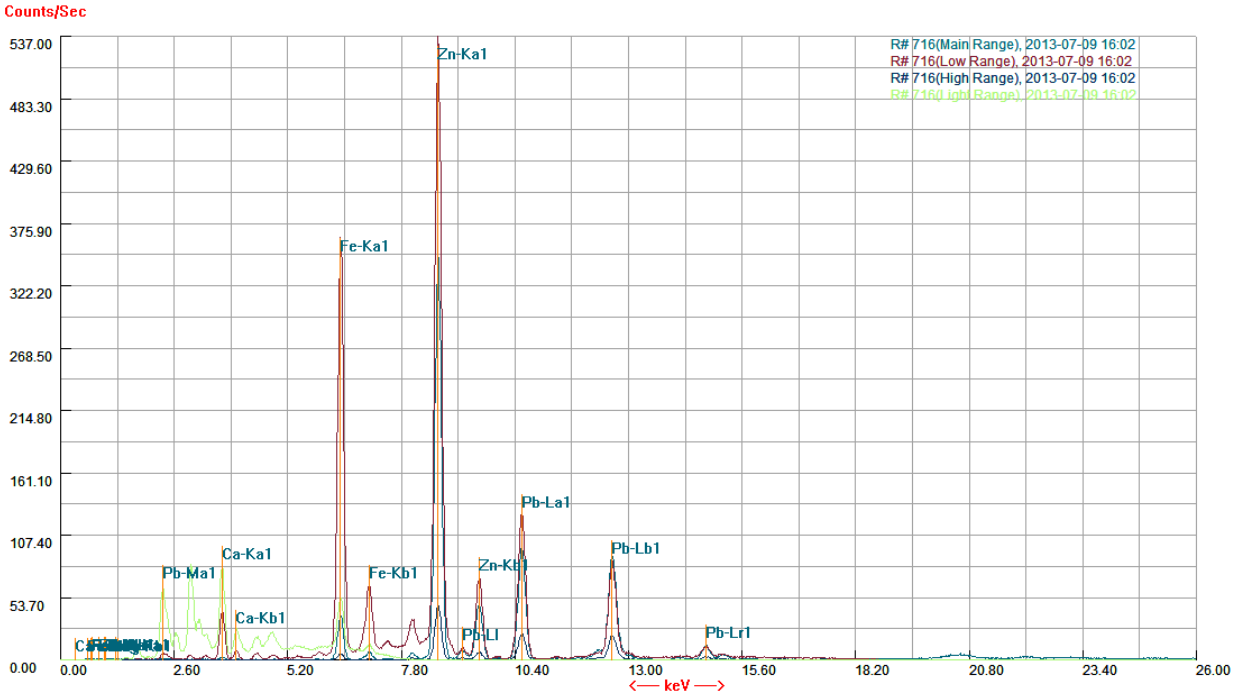


No 1053 – Secondary green, Pb, Ca, Fe, Cr, & Zn

Appendix 3
XRF Analysis



No. 1056 – Secondary blue, Pb, Ca, Fe, Zn & Cu



No 716 – Secondary blue, Pb, Ca, Fe, & Zn

Appendix 3 Optical microscopy and SEM-EDX

As mentioned, two paint samples have been extraction from this painting. Their location can be seen, in the Fig 3.1. These paint samples are labeled as CS-1 blue and CS-2 yellow. These two samples were extracted in order to gain a clear understanding regarding the application technique of the painting while also gaining information regarding the components found in the ground, two original paint layers, and one secondary paint layer. These extractions also made it possible to visually examine the secondary varnishes located on the painting through optical microscopy.

Additionally, it should be made clear that the two paint samples extracted from this painting, were primarily extracted in this specific case, since as a student it is required to practice sampling in this manner from paintings. However, it is recognized that this type of extraction will be far more restricted in any future conservation practice, due to its unethical implications of withdrawing original material from a cultural object (AIC 1994; ECCO 2002). Nevertheless, these extractions provided information regarding original and secondary material identification using SEM-EDX therefore, their extraction was justifiable.

Much like XRF, the SEM-EDX can identify elements found in small areas but on a much smaller scale. Additionally, this method of analysis enables a conservator to analyze the contents of a single layer in a cross section. And even micro areas, such as a single pigment particle, can be analyzed and its elements established (Matteini and Mazzeo 2009:83). Therefore, this method makes identification of paint samples more possible.

Fig 3.1 Location overview of extracted samples

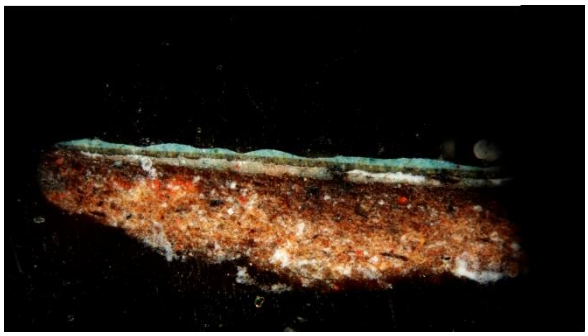


Fig 3.2 CS-1 blue, transmitted light

Fig 3.3 CS-2 yellow, transmitted light

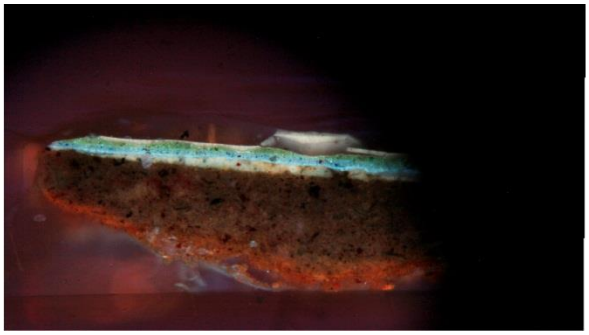


Fig 3.4 CS-1 blue, ultraviolet light

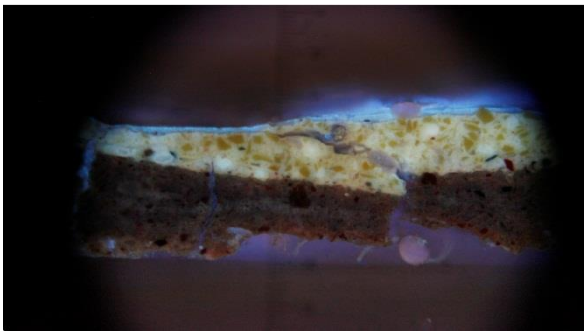


Fig 3.5 CS-2 yellow, ultraviolet light

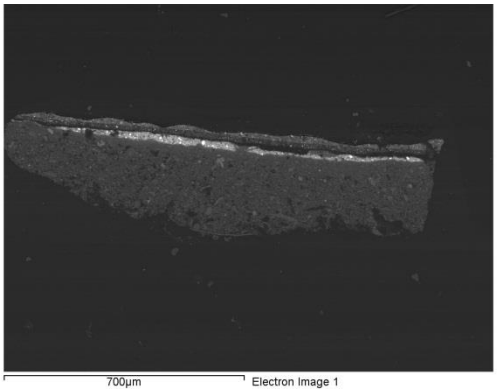


Fig 3.6 CS-1 SEM-EDX picture 1

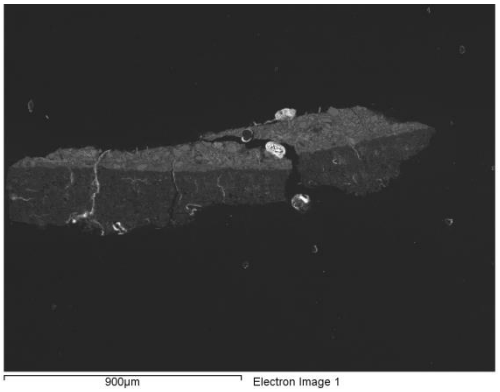


Fig 3.7 CS-2 SEM-EDX picture 1

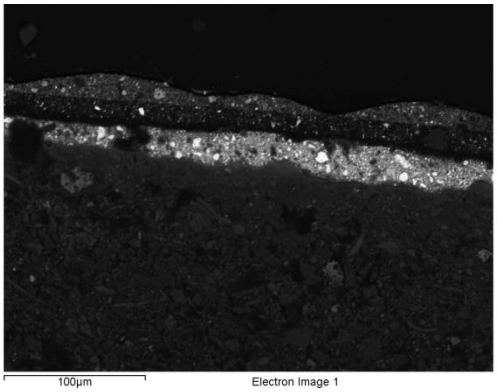


Fig 3.8 CS-1 blue, SEM-EDX picture 2

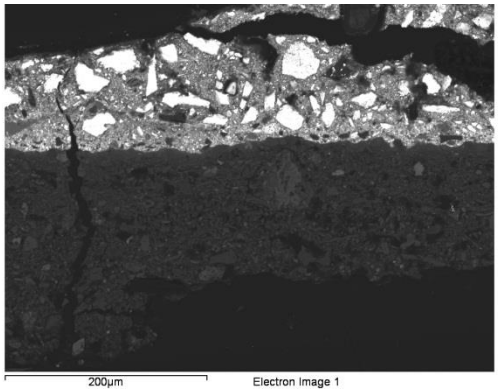


Fig 3.9 CS-2 yellow, SEM-EDX picture 2

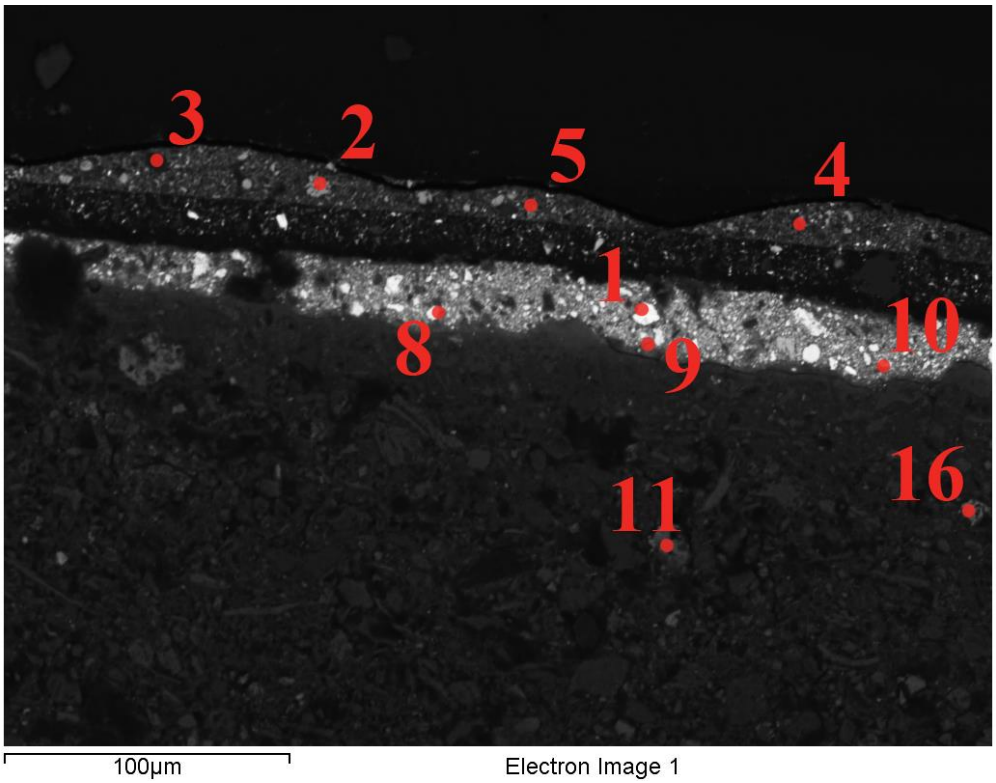


Figure 3.10 CS-1 blue Overview picture of the SEM-EDX picture 2

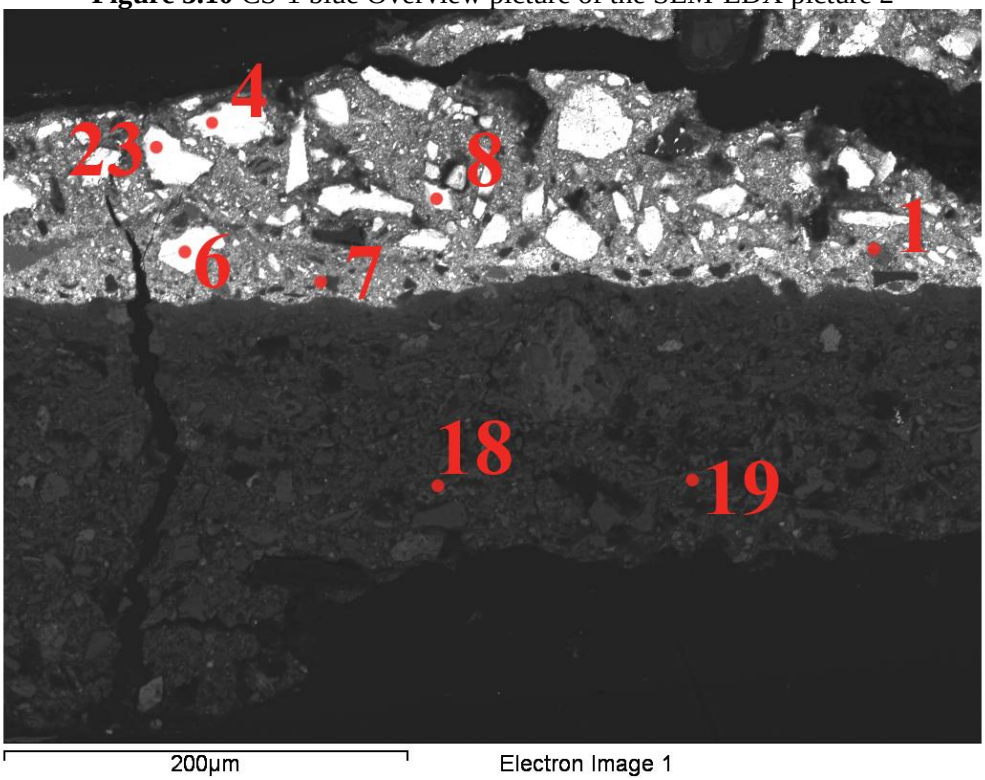


Figure 3.11 CS-1 yellow Overview picture of the SEM-EDX picture 2

THE GROUND

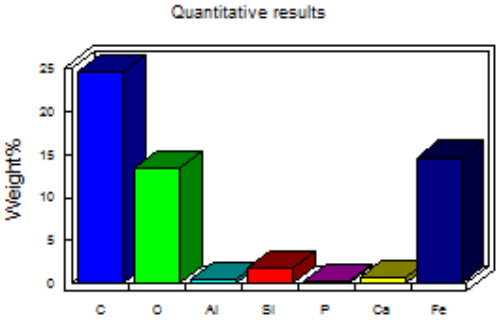


Fig 3.12 CS-1 blue ground spectra 11

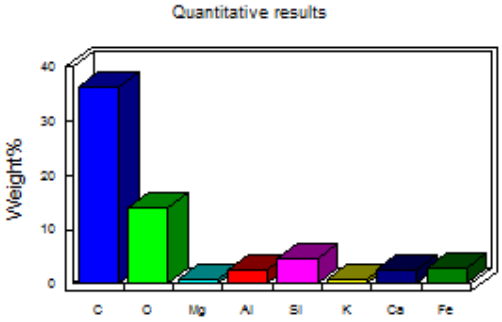


Fig 3.13 CS-2 yellow ground spectra 18

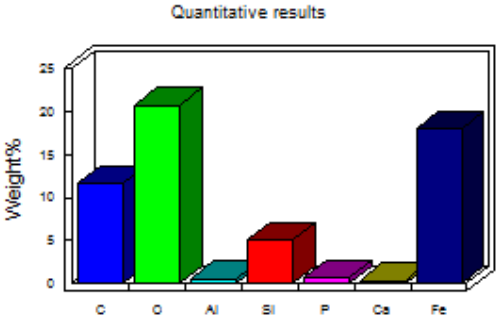


Fig 3.14 CS-1 blue ground spectra 16

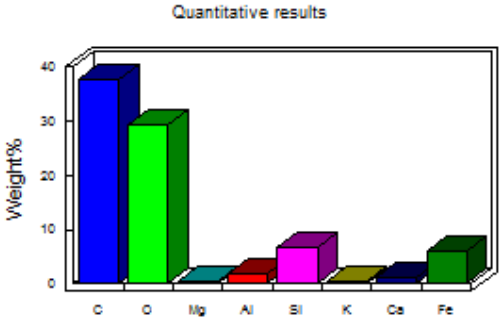


Fig 3.15 CS-2 yellow ground spectra 19

CS-2 YELLOW, ORIGINAL YELLOW

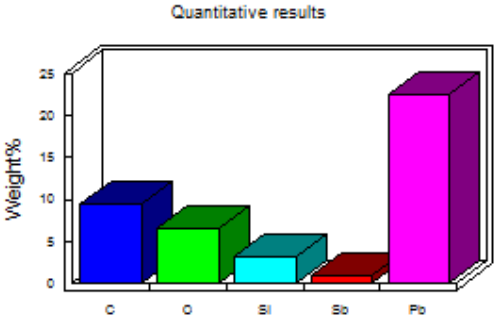


Fig 3.16 CS-2 yellow, original paint spectra 23

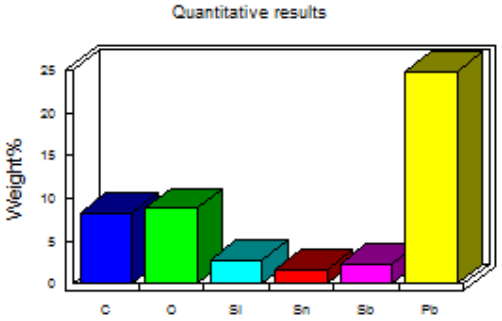


Fig 3.17 CS-2 yellow, original paint spectra 8

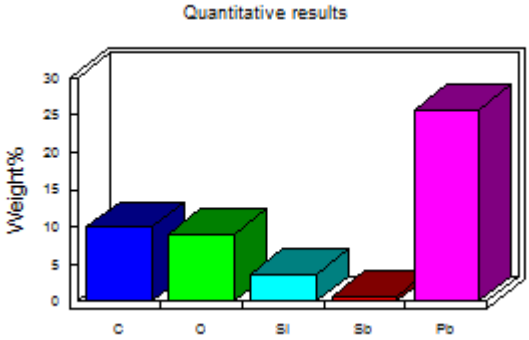


Fig 3.18 CS-2 yellow, original paint spectra 4

CS-2 YELLOW, ORIGINAL GREEN

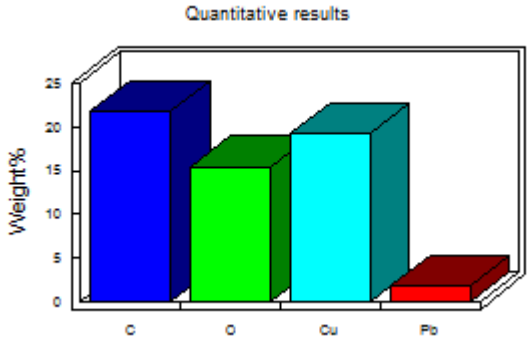


Fig 3.19 CS-2 yellow, original paint spectra 1

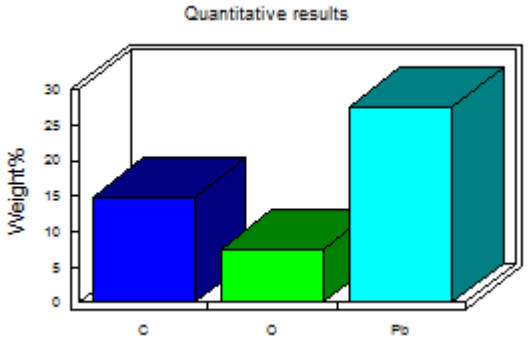


Fig 3.20 CS-2 yellow, original paint spectra 6

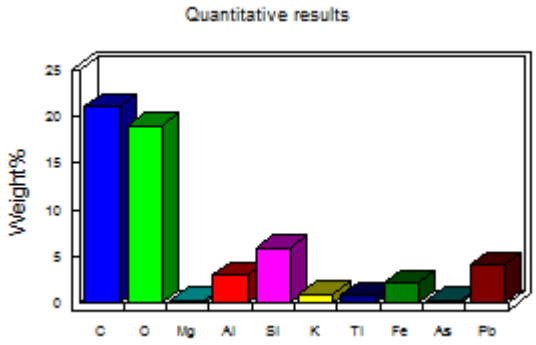


Fig 3.21 CS-2 yellow, original paint spectra 7

CS-1 BLUE, ORIGINAL REDDISH-WHITE

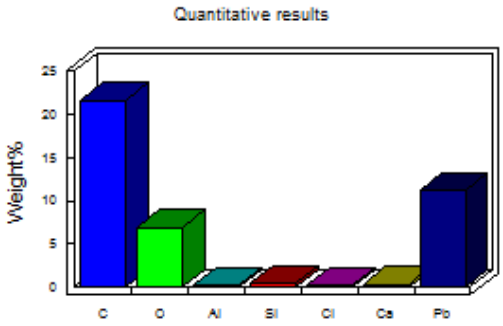


Fig 3.22 CS-1 blue, original paint spectra 9

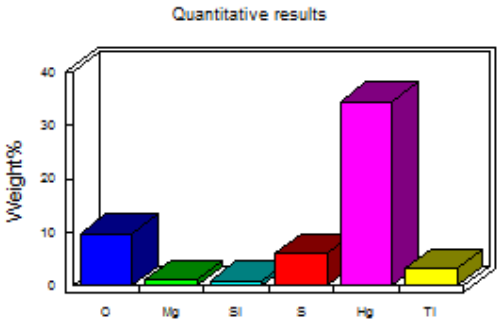


Fig 3.23 CS-1 blue, original paint spectra 1

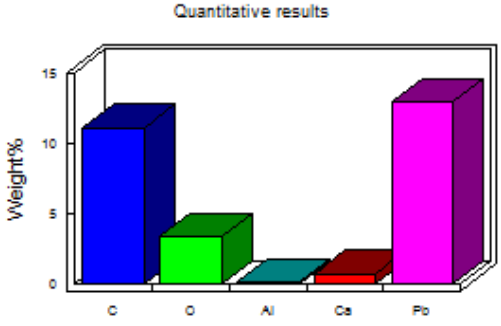


Fig 3.24 CS-1 blue, original paint spectra 10

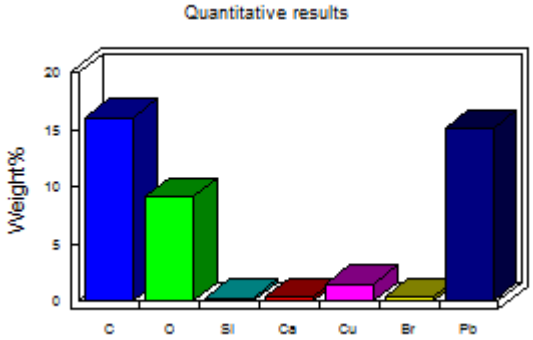


Figure 3.25 CS-1 blue, original paint spectra 8

CS-1 BLUE, SECONDARY BLUE

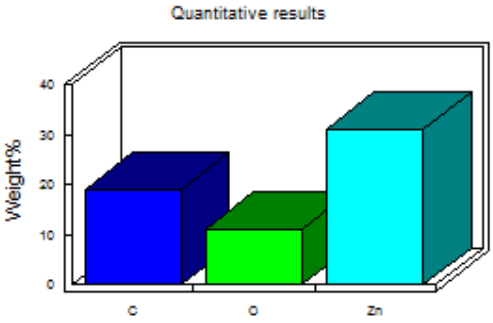


Fig 3.26 CS-1 blue, secondary paint spectra 2

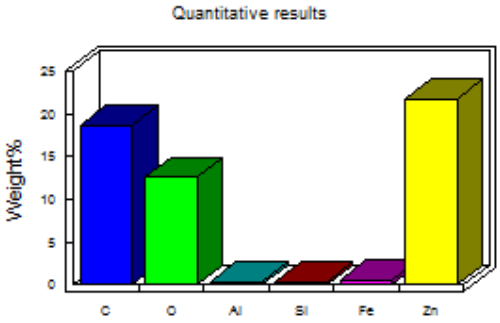


Fig 3.27 CS-1 blue, secondary paint spectra 4

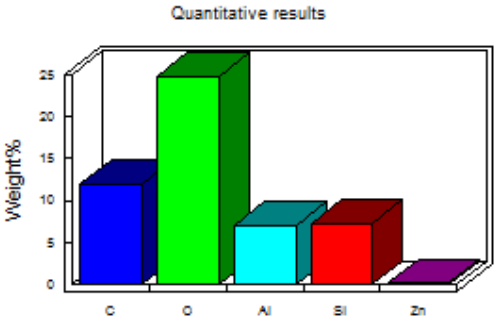


Fig 3.28 CS-1 blue, secondary paint spectra 3

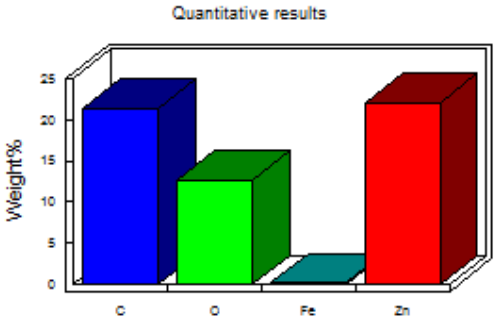


Fig 3.29 CS-1 blue, secondary paint spectra 5

MAPPING OF CS-1 BLUE

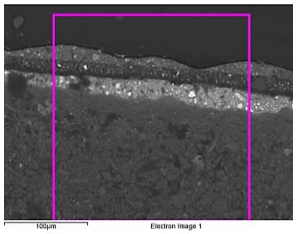
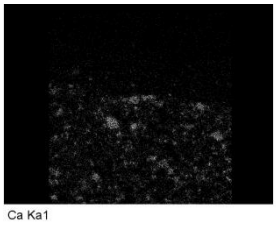
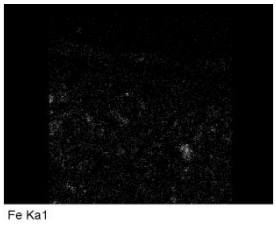


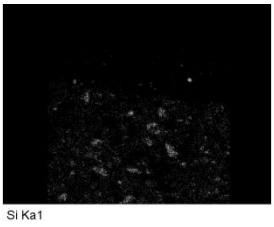
Fig 3.30 Overview image



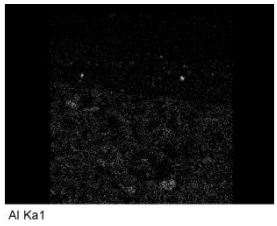
Calcium (Ca)



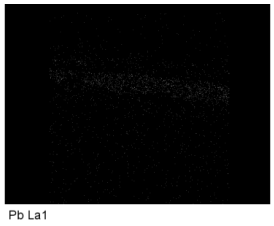
Iron (Fe)



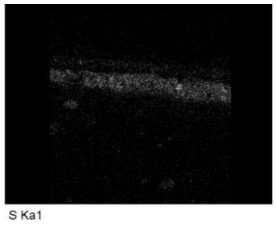
Silicon (Si)



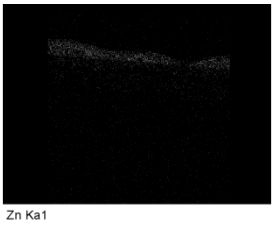
Aluminum (Al)



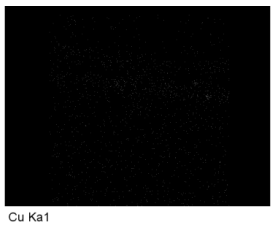
Lead (Pb)



Sulphur (S)

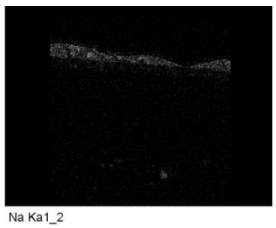


Zinc (Zn)



Copper (Cu)

Bromine (Br)



Sodium (Na)

MAPPING OF CS-2 YELLOW

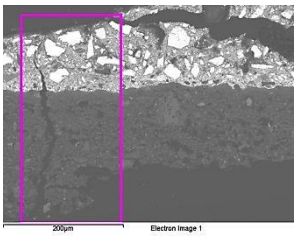
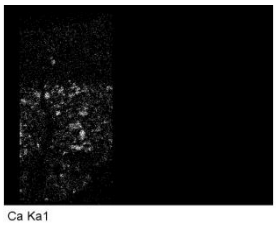
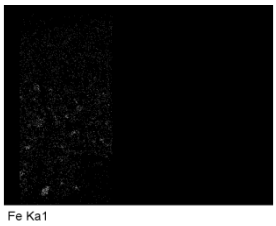


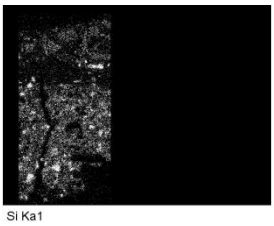
Fig 3.31 Overview image CS-2



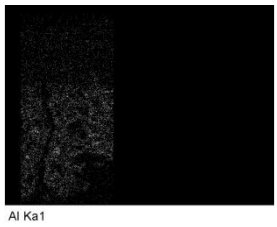
Calcium (Ca)



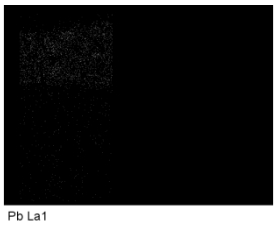
Iron (Fe)



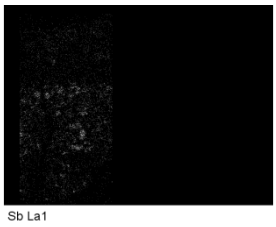
Silicon (Si)



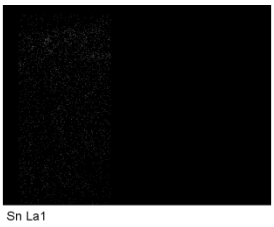
Aluminum (Al)



Lead (Pb)



Antinomy (Sb)



Tin (Sn)

Appendix 4 Original and Secondary canvas

Two original canvas threads were also extracted from the painting in order to further identify the actual type of material it was made of. This was performed since identification may, would identify the canvas condition and also justify in the reasons in carrying out of a delining treatment and if so what materials would be required to be used in the 2013/2014 treatment. Identification of the canvas fiber was performed through optical microscopy investigations of the canvas both in longitudinal and in cross sections. These fibers were investigated in the polarization microscope (Leica PLM 2000) using transmitted and reflected light. The threads were chosen due to accessibility and since they were already loose from the canvases. They were removed by the use of a tweezer and scalpel.

The approximate location of each extraction is illustrated in the Fig 4.1. The corresponding number for each type of thread is indicated in the chart below:

1A	*Original canvas, horizontal thread*
2A	*Original canvas, vertical thread*
1B	*Secondary canvas, horizontal thread*
2B	*Secondary canvas, vertical thread*

A twist test of the one original microfiber (1A) and one secondary microfiber (2B) helped to further confirm the identity of the original canvas material as this test can help differentiate between flax and hemp. The procedure was performed according to Wiener, Kovačič and Dejlovà (2003) description and is based on the observation concerning the direction the microfibers will twist when they dry. If they twist towards the right, then the micro fibers are made of hemp, while if they twist to the left they are made of flax. (Fig 4.17 & 4.18) During the performance of the twist test, the fibrous material twisted ‘counter clockwise’, confirming that the fibrous material was indeed hemp (Wiener, Kovačič and Dejlová 2003:60). Since optical microscopy had identified the probability that all extracted threads were most likely hemp, this test was merely performed to confirm its credibility.

A thread count (4.19 & 4.20) of 2 cm x 2 cm was performed on the original canvas to identify its weave structure. X-ray could have also been used to help identify weave structure, however for this painting, due to it having been previously lined, this method of analysis gave inconclusive results as it was difficult to differentiate between the two canvases when they were attached to one another. Fourier transform infrared spectroscopy (FTIR) was also an option that could have been performed for identification purposes. However, due to the strong identification already achieved through the use of optical microscopy and the twist test this testing method was avoided.

Through optical microscopy, hemp was identified by means of its typical characteristics mentioned by Cook (1993:17-19) and Catling and Grayson (1998:22-23). Typical characteristics of hemp fibers in longitudinally sections are frequent dislocations with regular spaced cross-markings that can (but not always) extend completely across fiber cells. For transverse sections of hemp, distinctive characteristics

include a varied shape of the sclerenchyma cells having between four to six angular sides with either elongated, star shaped or irregular lumen. All of these characteristics, both longitudinally and transversely, are observable in the Figures 4.2-4.16.

Fig 4.1 location of the extraction sites of the canvas threads

1A Original canvas, horizontal thread

Identified as: hemp, through optical microscopy and twist test.

Comments regarding extraction: The length of this sample was 1.2cm. 60% of this sample was covered in brown paint (most likely secondary paint) and the thread was easily brittle during the extraction. It was difficult to extract due to the fact that it was saturated in dried secondary paint.

Condition: During the performance of the thread folding test, mentioned by Oriola (et al 2011), the thread broke after 6 folds, labeled as a category 3.

However, during the folding test small micro fibers shredded off when it was being folded, and this should be taken into consideration regarding condition.

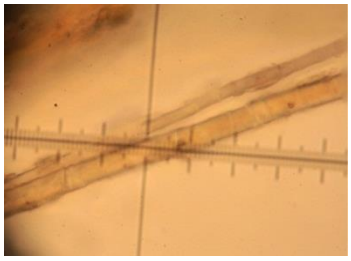


Fig 4.2 1A transmitted light

Cross-section not available

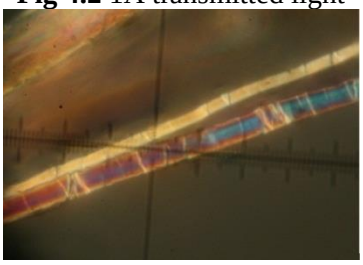


Fig 4.3 1A polarization light 1

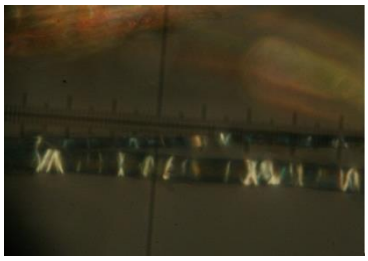


Fig 4.4 1A polarization light 2

2A Original canvas, vertical thread

Identified as: hemp, through optical microscopy.

Comments regarding extraction: The length of this sample was 0.8cm.

Condition: During the performance of the thread folding test, mentioned by Oriola (et al 2011) this thread did not break after being folded 10 times, labelled is as a category 4.

However, several fibers were severed at the folded joint and during the folding test small micro fibers shredded off when it was being folded. This should be taken into consideration regarding condition.

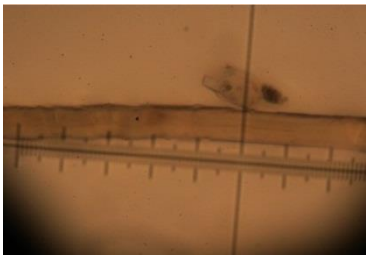


Fig 4.5 2A transmitted light

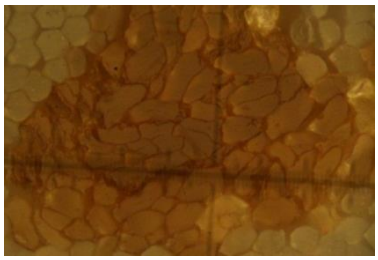


Fig 4.6 2A cross-section

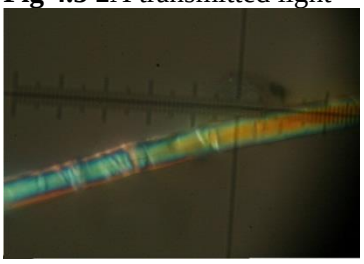


Fig 4.7 2A polarization light 1

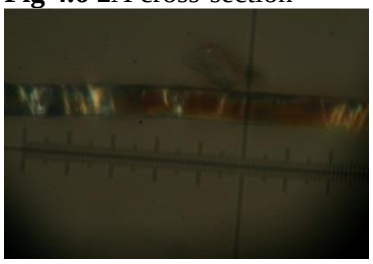


Fig 4.8 2A polarization light 2

1B Secondary canvas, horizontal thread

Identified as: hemp, through optical microscopy.

Comments regarding extraction: The length of this sample was 3.2cm. There was a clear difference between the original and secondary canvas extractions as the secondary canvas was more elastic and sturdier then the original canvas.

Condition: During the performance of the thread folding test, mentioned by Oriola (et al 2011), the thread broke after 2 folds, labelled as a category 2.

Fig 4.9 1B transmitted light

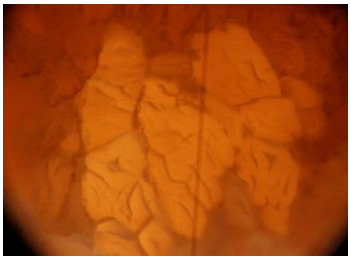


Fig 4.10 1B cross-section

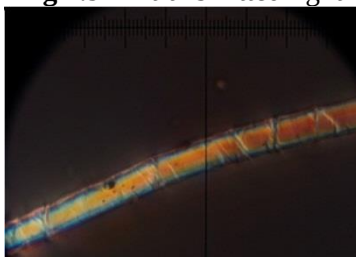


Fig 4.11 1B polarization light 1

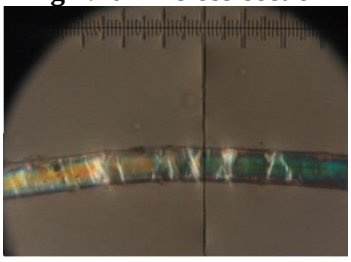


Fig 4.12 1B polarization light 2

2B Secondary canvas, vertical thread

Identified as: hemp, through optical microscopy and twist test.

Comments regarding extraction: The length of this sample was 1.8cm. There was a clear difference between the original and secondary canvas extractions as the secondary canvas.

Condition: During the performance of the thread folding test, mentioned by Oriola (et al 2011) this thread did not break after being folded 10 times, labelling is as a category 4.

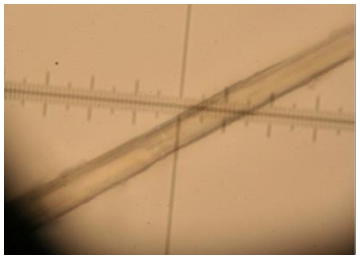


Fig 4.13 2B transmitted light

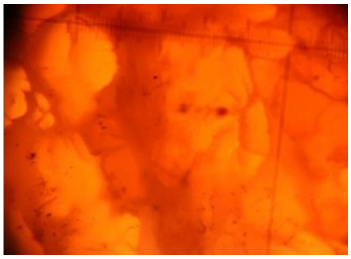


Fig 4.14 2B cross-section

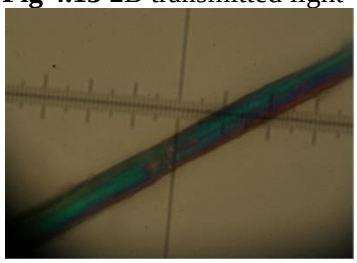


Fig 4.15 polarization light 1

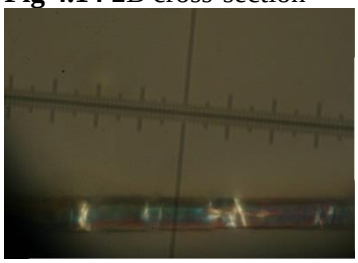


Fig 4.16 polarization light 2

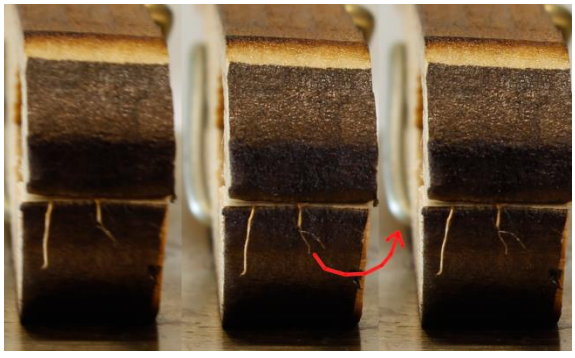


Fig 4.17 1A images taken during twist test investigation. Illustrating a ‘counter clockwise’ movement.

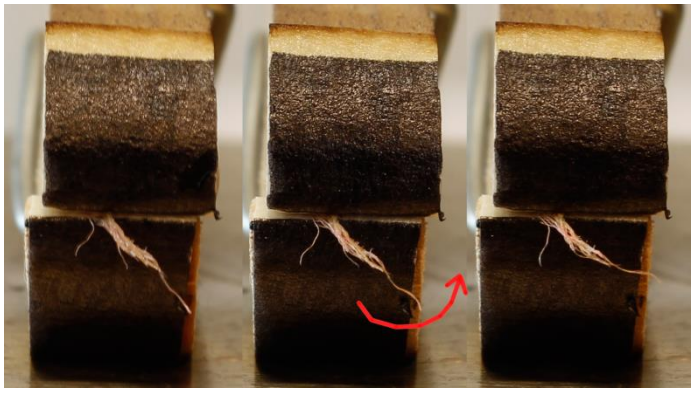


Fig 4.18 2B images taken during twist test investigation. Illustrating a ‘counter clockwise’ movement.

Appendix 4
Original and Secondary canvas information

ORIGINAL CANVAS:

Measures: (in cm)	H: 65-67 cm / L: 49-49.5 cm / D: 0.1 cm (no tacking margins are available) Woven fabric
Weave structure:	Plain tabby weave. No selvedge is available. Thus, warp or weft cannot be identified.
Fiber analysis:	*Direction of twisting of yarn:* H: Z / V: Z, *Direction of twist test:* Counter Clockwise *Fibre type:* Hemp
	Analysis method: Visual, stereomicroscopy (10-50x), optical microscopy (10x-63x), sampling, folding test, pH test, and twist test

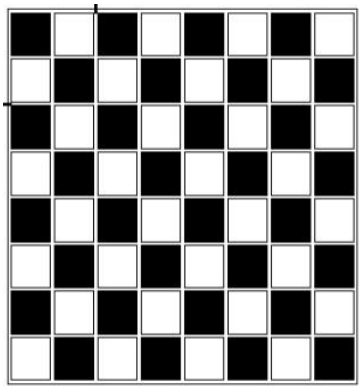


Fig 4.19 Original canvas weave structure

Plain tabby weave, H=□ / V=■

Nr. of yarn	**H:** 19 threads on 2 cm											**V:** 17 threads on 2 cm											
Thickness of the yarns	**H (in mm):**	*9*	*8*	*6*	*8*	*11*	*8*	*6*	*7*	*7*	*6*	*6*	*9*	*7*	*6*	*11*	*10*	*7*	*5*	*7*			**Avg = 7.2 mm**
	V (in mm):	*11*	*12*	*11*	*10*	*9*	*6*	*6*	*7*	*8*	*8*	*9*	*7*	*7*	*8*	*6*	*10*	*8*					**Avg = 6.8095 mm**
Weave filling:	**A_H = 72%**				**A_V = 71.5%**							**A_{HV} = 71.75%**											

Appendix 4
Original and Secondary canvas information

SECONDARY CANVAS:

Measures: (in cm)	H: 70.2-70.5 cm / L: 50 cm / D: 0.1 cm (no tacking margins are available) Woven fabric
Weave structure:	Plain tabby weave. No selvedge is available. Thus, warp or weft cannot be identified
Fiber analysis:	*Direction of twisting of yarn:* H: Z / V: Z, *Direction of twist test:* Counter Clockwise *Fibre type:* Hemp
	Analysis method: Visual, stereomicroscopy (10-50x), optical microscopy (10x-63x), sampling, folding test, pH test, and twist test

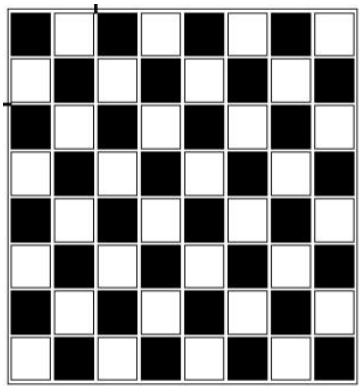


Fig 4.20 Original canvas weave structure — Plain tabby weave, H=□ / V=■

Nr. of yarn	**H:** 20 threads on 2 cm											**V:** 21 threads on 2 cm											
Thickness of the yarns	**H (in mm):**	*5*	*4*	*12*	*4*	*5*	*4*	*6*	*5*	*4*	*4*	*3*	*5*	*5*	*6*	*5*	*6*	*7*	*8*	*7*	*6*		**Avg = 6.45 mm**
	V (in mm):	*8*	*6*	*9*	*5*	*6*	*11*	*10*	*9*	*9*	*9*	*9*	*9*	*10*	*8*	*7*	*5*	*6*	*5*	*7*	*8*	*7*	**Avg = 7.7619mm**
Weave filling:	**A_H = 64.5%**				**A_V = 81.5%**							**A_{HV} = 73%**											

Appendix 5 pH testing

SECONDARY CANVAS

backside, while the painting was still lined

Performed using neutral pH 7 distilled H_2O

1 = pH 4.7-5.8 (splotchy, more 4.7 then 5.8)

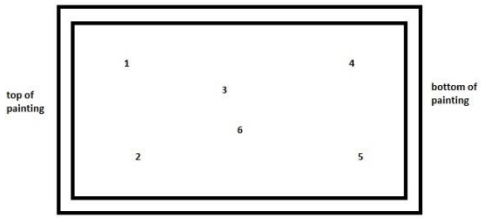
2 = pH 4.7-5.3 (even amount)

3 = pH 5.0-6.5 (splotchy, even amount)

4 = pH 4.7-5.8 (splotchy, even amount)

5 = pH 5.0-6.5 (splotchy, more 5.0 then 6.5)

6 = ca. pH 5-6



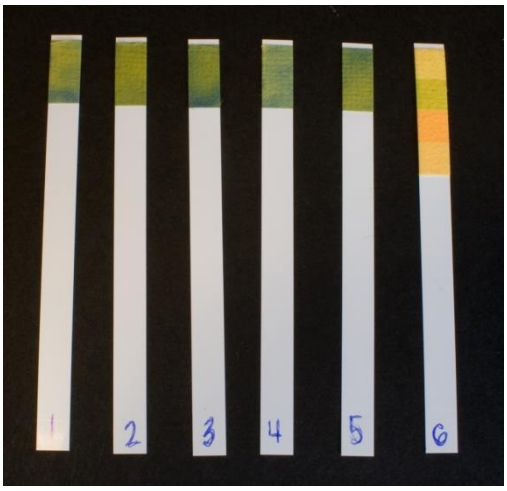


Fig 5.1 pH strips of secondary canvas

ORIGINAL CANVAS

backside, cleaned and not cleaned of its lining glue

Performed using neutral pH 7 distilled H_2O

Performed on the backside of the original canvas after the lining had been taken off and cleaning tests of the glue had been performed

Glue – pH 4.4-5.3

Clean – pH 5.6-6.5

Water – pH 7

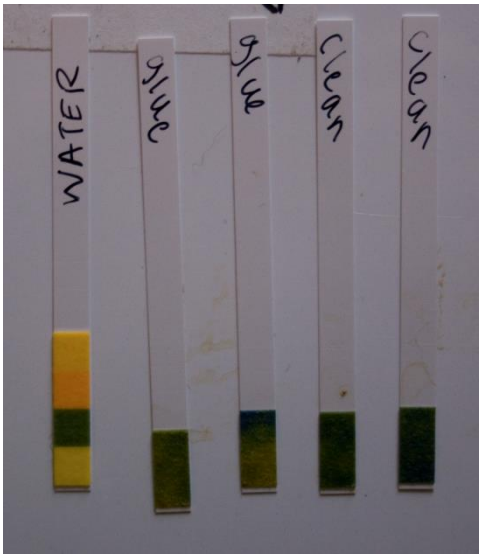


Fig 5.2 pH strips of original canvas, cleaned and not cleaned of the lining glue

Appendix 6 Stretcher glue

Solubility tests indicated that this glue was water soluble. FTIR analysis pointed out that the glue had a similar infrared spectroscopy graph for most animal glues. Therefore, it was deduced that this glue was most likely an animal glue.

In the image to the right it was clearly visible where the adhesive was located as it fluoresced strongly in ultraviolet illumination. The samples used for chemical testing were extracted in the paintings lower left hand corner, using a scalpel.

It was important to understand what this glue was made of, since it therefore could be argued for why it should be removed.

Fig 6.1 The white fluorescence of the Stretcher glue under UV illumination

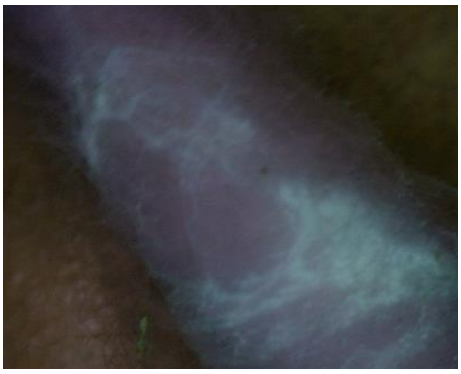


Fig 6.2 A water cotton swab of the adhesive, illustration that it was also soluble in water

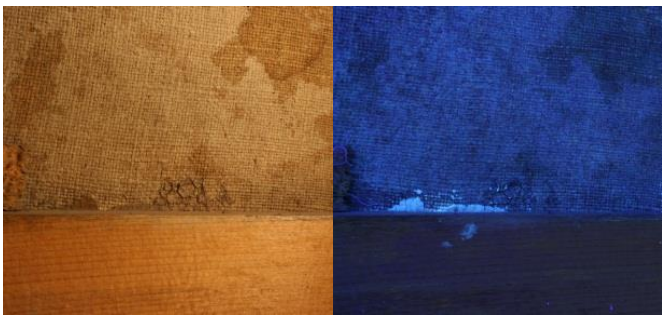


Fig 6.3 Extraction site of the stretcher glue. Glue in natural visible light and in ultraviolet illumination

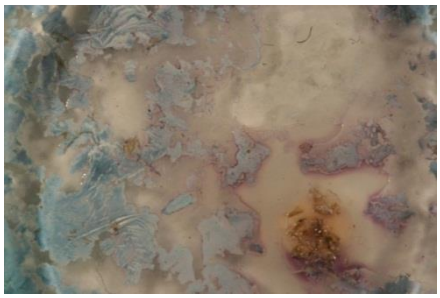


Fig 6.4 Turned purple during the Protein test in copper(II) sulfate

Appendix 6
Stretcher glue

Fourier Transform Infrared Spectroscopy (FTIR) of the Stretcher glue

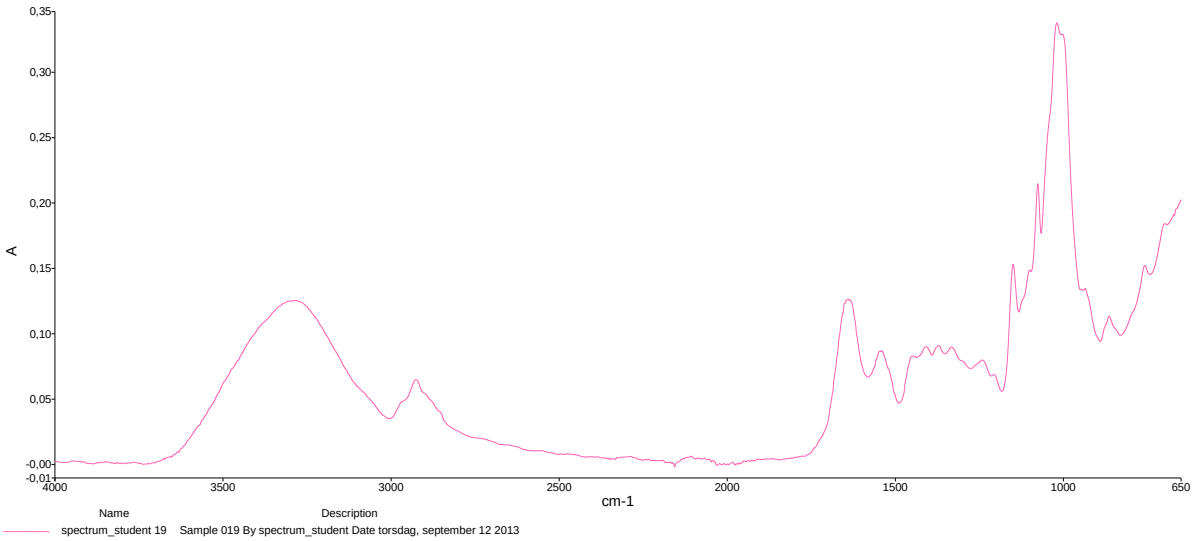


Fig 6.5 FTIR absorption graph of Stretcher glue

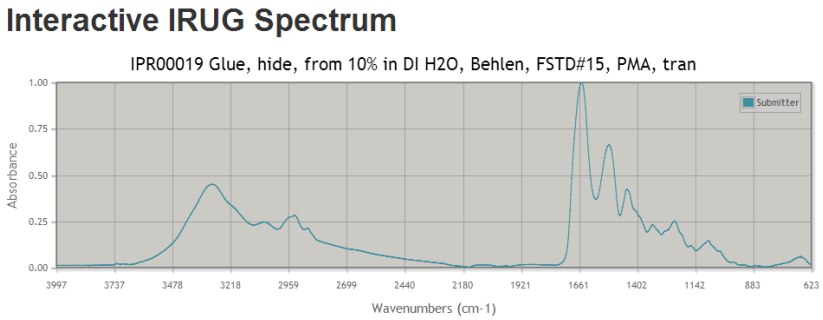


Fig 6.6 FTIR absorption graph of a reference sample. Proteinaceous materials, glue, hide, from 10% in deionized H_2O (IRUG)

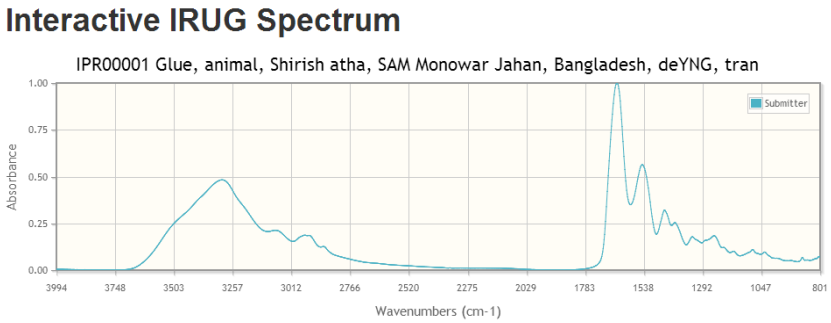


Fig 6.7 FTIR absorption graph, of a reference sample. Proteinaceous material, glue, animal, shirish atha. (IRUG)

Appendix 7 Lining Glue

It was clear that throughout the entire backside of the secondary canvas there was another crusty substance. In the two images to the right (one in visible light and one in ultraviolet light), it is noticeable that this crusty substance does not fluoresce as intensely as the adhesive used to attach the stretcher to the canvas.

Solubility tests and chemical tests for protein and starch were performed on extracted samples of this crusty glue. The results indicated that this glue was soluble in water, was not proteinase, contained starch and had a similar Infrared spectroscopy graph for most vegetable glues. Through these results it was clear that this substance was the glue used in the glue lining, and was most likely a starch glue.

Fig 7.1 – extraction site

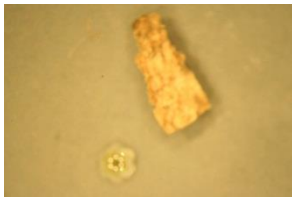


Fig 7.3 Test for starch, dark purple

Fig 7.4 – residue of glue lining tested with iodine

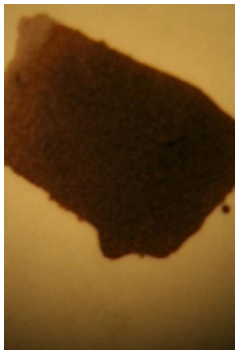


Fig 7.5 – residue of control test, oatmeal, tested with iodine

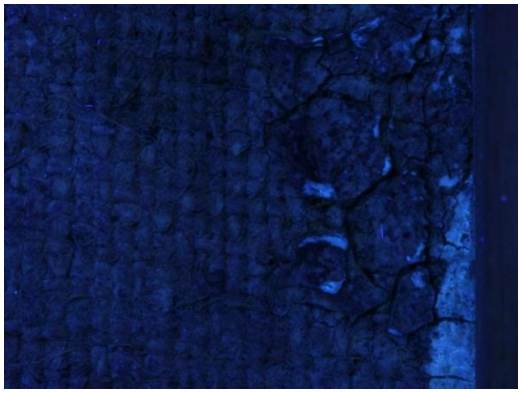


Fig 7.2 - Same area as Fig 1 under ultraviolet illumination

Appendix 8 Colour Stratigraphy Chart

Colour stratigraphy chart:

This section of the painting has been divided into 13 distinguishing areas within 7 different major colours. All colour areas contain the following four primary layers, yet they are only described in the Chart under ID no. 201:

1. **Original canvas**
2. **Glue sizing**
3. **Ground - imprematura**
4. **Isolation layer**

Headings in the Colour Stratigraphy Chart and what they mean:

Cat. no - Category number
Colour – Main colour of the area
ID No. – Identification number
Loc (Location) – Descriptive area of the motif
Strat (Stratigraphy) – Application layer divisions
App (Application) – The application method: M: Modelled, Mch: Monchrome, D: drawn
OPQ? (Opacity) – OPQ:Opaque, TRSL: Translucent, TRSP: Transparent
Vis. (Visual analysis)– Type of visual analysis
Samp (Sample) – Sampling no. (Appendix 3)
FCIR – False Colour Infrared images (Appendix 1)
XRF – XRF no. and the majority of the elements found during analysis
SEM-EDX – Sample no., the crucial elements found during analysis
X-ray – The colour emitting during X-ray
Pigment? – the possible pigment identified in each layer

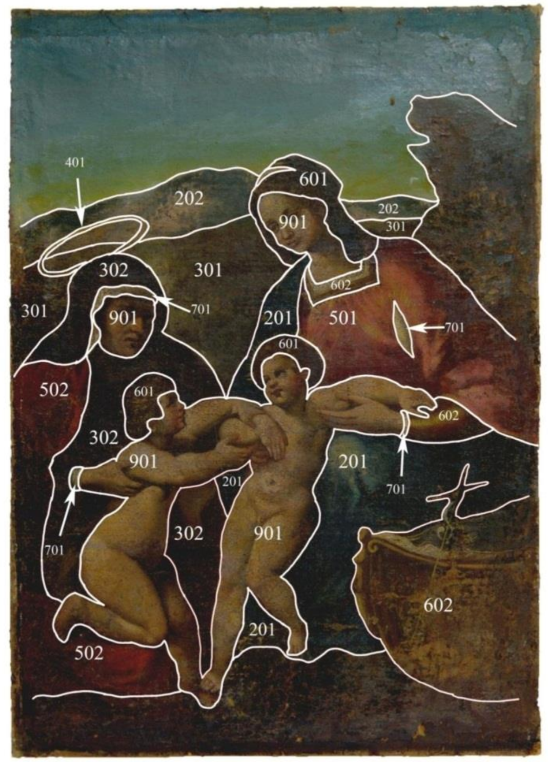


Fig 8.1 Overview of designated colour areas

Appendix 8
Colour Stratigraphy chart

Cat. no., Colour and ID No.			Loc	Strat	App	OPQ ?	FCIR & X-ray	XRF	SEM-EDX	Pigment?
1	Blue	201	St. Mary's cloak	7 Yellow	D	OPQ	FCIR: Magenta X-ray: Dark Grey – Light Grey	No. 728 Pb, Ca, Fe, Cu	--	7 Lead-tin yellow? Lead-tin-antinomy yellow? Lead antimonate yellow?
				7 Dark blue	MCH	TRL			--	7 Azurite? Blue verditer? Prussian blue?
				6. Light blue and dark blue	M	OPQ			--	6 lead white with - Azurite? Blue verditer? Prussian blue?
				5. Blue	MCH	OPQ			--	5 Azurite? Blue verditer? Prussian blue?
		Pertaining to all areas		4 Isolation layer	--	--			--	
				3 Ground					CS-1 blue & CS-2 yellow C, O, Fe, Ca, Si, K, Al, Mg, P	3 Gypsum pigmented with burnt umber
				2 Glue sizing	--	--	--	--	--	
				1 Original canvas	--	--	--	--	--	
2		202	The upper landscape	7 Blue	M	OPQ	FCIR: Bluish green X-ray: Dark Grey – Light Grey	No. 717 Pb, Ca, Fe, Cu, Hg,	--	6 Azurite?
				6 Green	M	OPQ			--	5 Azurite? Malachite?
				5 Light green	MCH	OPQ			CS-2 yellow Cu, Pb C, O, Mg; Al Si, K, Ti, Fe, As	5 Lead white with - Azurite? Malachite?
3		203	Sky	7 Dark blue	M	OPQ		No. 1049 Pb, Ca, Fe, Zn, Cu,	--	7 Azurite? Blue verditer?
				6 Blue	M	TRSL			--	6 Azurite? Blue verditer?
				5 Reddish-white	M	OPQ			CS-1 blue C,O, Pb, Ca, Al, Si, Cu, Br, Mg, Hg, S	5 Cinnabar with lead white?

Appendix 8
Colour Stratigraphy chart

Cat. no., Colour and ID No.			Loc	Strat	App	OPQ ?	FCIR & X-ray	XRF	SEM-EDX	Pigment?
4	Green	301	The lower landscape	7 Light green and blueish green	M	OPQ	FCIR: Bluish green X-ray: Dark Grey – Light Grey	No. 1024 Pb, Fe, Ca, Cu	--	7 Azurite? Malachite?
				6 Green	M	OPQ			--	6 Azurite? Malachite?
				5 Light green	MCH	OPQ			CS-1 blue?	5 Lead white with – Azurite? Malachite?
5		302	St. Elizabeth's dress	7 unknown layering structure	--	--	FCIR: X-ray:	No. 1026 Pb, Ca, Fe, Mn, Cu	--	7 unknown pigment
				6 Light green?	M	--			--	6 verdigris? Mixed with lead white?
				5 unknown layering structure	--	--			--	5 unknown pigment
6	Yellow	401	St. Mary's, Elizabeth's, and Jesus' halos	7 Yellow	D	OPQ	FCIR: light yellow X-ray: white	No. 1029 Pb, Fe, Sn, Sb, Ca	CS-2 yellow Pb, Sn, Sb, Si	7 Lead-tin yellow? Lead-tin-antinomy yellow? Lead antimonate yellow?
				6 *					--	6 *
				5 *					--	5 *
7	Red	501	St. Mary's dress	7 yellow	D	OPQ	FCIR: Yellow X-ray: Light Grey-White	No. 726 Pb, Fe, Hg, Ca,	--	7 Lead-tin yellow? Lead-tin-antinomy yellow? Lead antimonate yellow?
				7 red glaze	MCH	TRSL			--	7 Madder?
				6 light red	M	TRSL			--	6 Cinnabar mixed with lead white
				5 light red	MCH	OPQ			--	5 Cinobar mixed with Lead white
8		502	St. Elizabeth's cloak	7 red glaze	M	TRSL	**FCIR:** Orange **X-ray:** Dark Grey - Light Grey	No. 722 & 723 Pb, Ca Fe (Mn)	--	7 madder?
				6 light red	M	OPQ			--	6 red iron oxide, mixed with lead white
				5 red	MCH	OPQ			--	5 red iron oxide

Cat. no., Colour and ID No.			Loc	Strat	App	OPQ ?	FCIR & X-ray	XRF	SEM-EDX	Pigment?
9	Brown	601	The hair of all the figures	6 Yellow	D	OPQ	**FCIR:** Dark brown, almost black **X-ray:** Dark Grey	--	--	6 Lead-tin yellow? Lead-tin-antinomy yellow? Lead antimonate yellow?
				5 Dark brown	M	OPQ			--	5 Brown iron oxide?
10		602	Crib, St Mary's sleeve and collar.	7 Yellow	D	OPQ	**FCIR:** Brown, dark brown **X-ray:** Black	--	--	7 Lead-tin yellow? Lead-tin-antinomy yellow? Lead antimonate yellow?
				7 White	D	OPQ			--	7 Lead white
				6 Dark red with brown	M	OPQ			--	6 madder? Red iron oxide? mixed with brown iron oxide
				5 Brown	MCH	OPQ			--	5 Brown iron oxide
11		603	Tree	7 unknown layering structure	--	--	--	--	--	7 unknown pigment
				6 unknown layering structure	--	--			--	6 unknown pigment
				5 unknown layering structure	--	--			--	5 unknown pigment
12	White	701	St. Elizabeth's veil and sleeve, plus St. Mary's headband	7 white	D	OPQ	**FCIR:** White X-ray: White	--	--	7 lead white?
				6 Grey	M	OPQ/ TRSL			--	6 lead white – with unknown grey pigment
				5 Brown	MCH	TRSL			--	5 unknown brown pigment
13	Skin tones	901	St. Elizabeth, St. Mary, infant Jesus and infant St. John the Baptist.	7 Black	D	OPQ	FCIR: light green and light white X-ray: Grey – white	No. 718 & 719 Pb, Ca, Fe	--	7 black iron oxide?
				7 Redish brown	M	TRSL			--	7 madder? Mixed with unknown brown pigment?
				6 White	M	OPQ			--	6 lead white
				5 Brown	M	TRSL			--	5 unknown brown pigment

*please see these layers of sky (203), lower (301) landscape, *and St Mary's cloak (201)*

Appendix 9 Preventive Conservation

Preventive conservation: Lux and UV measurements taken in the locations of where this painting currently hangs. Fig 9.1 illustrates the temperature and RH measurements taken for the 9 months. The temperature and RH were taken with a Thermohygrograph, Lambrecht 252 (set to 31 days) economy, while the lux and UV were taken with an Elsec 764 UV plus monitor.

Date	Lux	UV	Weather outside
10 Feb.	4,1 lux	0	Cloudy
7 Mar.	20 lux	0	--
4 April	31.5 lux	1	Sunny, no clouds
3 May	19,3 lux	0	Overcast
3 June	46 lux	0	Sunny, no clouds
3 July	25 lux	0	Overcast
2 Aug.	15.7	0	Overcast
3 Sept.	*No battery*	*No battery*	--
8 Oct.	17 lux	0	Sunny, no clouds
8 Nov.	20 lux	0	Sunny, no clouds
11 Dec.	5,4 lux	0	Overcast, snow

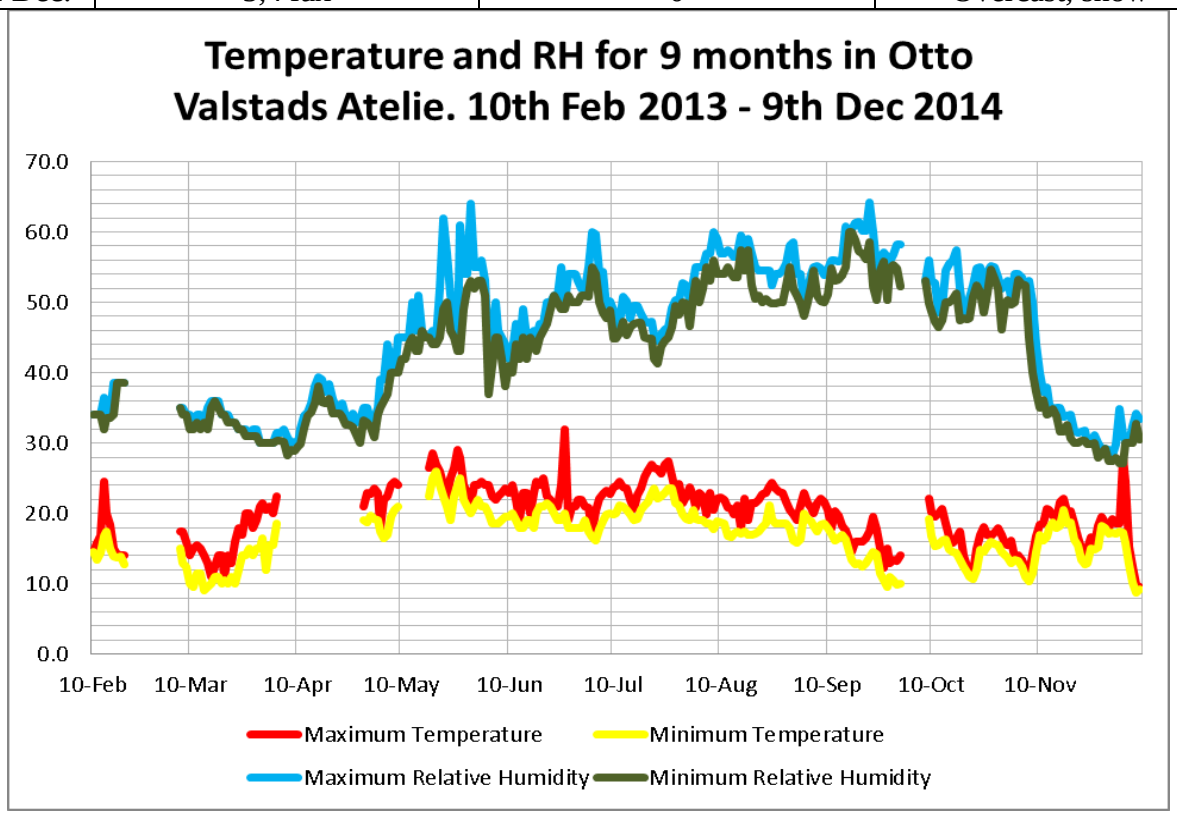


Fig 9.1 Temperature and RH for 9 months in Otto Valstads Atelie. Readings taken from February 10th 2013– Dec 9th 2014

Appendix 10 Materials used during the 2013/2014 Treatment

	Material	Activity:	Recipe:	Manufacturer:
1	Saliva	Surface dirt removal	--	--
2	Iso-propanol	Varnish and secondary paint removal	--	Arcus
3	Isopropanol/ benzylalcohol gel	Varnish and secondary paint removal	100 mL Isopropanol 10 mL benzylalcohol 10 mL water 20 mL Ethomeen C25 2 gr Carbopol EZ	--
4	Paint stripper	Varnish and secondary paint removal	Approx. 30% benzylalcohol (no other ingredients are mentioned on the lable)	--
5	Pembulen 6.5 pH mixture (No solvent)	Secondary paint and surface dirt removal		
6	White spirit		--	Arcus
7	Lascaux Medium for Consolidation (Hedlund and Johansson 2005)	Consolidation adhesive	--	Lascaux
8	Beva 371 film (Berger 1975)	Striplining adhesive	--	Kremer Pigmente
9	Polyester sailcloth	Striplining canvas	--	Lascaux
10	Lascaux 375 facing	Facing adhesive	2 parts white spirit 1 part Lascaux 375	--
11	Klucel J (Berger and Russel 2000:336)	Removal of previous lining adhesive	10 gr Klucel J 60 gr water 30 gr ethanol **Klucel J is slowly added last and the whole solution should sit cold overnight prior to use*	--
12	Beva 371 solution: Kaolin (2:1) (Fuster-López 2012:591)	Filler material	2 gr *Lascaux 375 1 gr Kaolin *Lascaux 375 is considered equivalent to Beva 371 solution	--
13	Gouach tempera colours	Retouching materials	--	Talens
14	Japanese facing tissue	Facing tissue	--	T.N. Lawrence & Son
15	MS2A varnish	Varnishing	--	Linden Chemicals
16	Brown Craft Paper	Tempoary mounting	--	--

Appendix 10 Time Spent on the 2013/2014 investigations and treatment

Type of investigation/treatment	**Hours**
All investigations, including visual investigations, photo-analytical, XRF, sampling, FTIR, SEM-EDX (including preparation)	168 hours
Photographing	42 hours
Facing, including preparation and removal	2 hours
Delining	5 hours
Glue removal on the back of the original canvas	26 hours
Temporary mounting to a working frame	3 hours
Consolidation	6 hours
Striplining, with preparation	17 hours
Reconstructions	16 hours
Surface dirt removal, front of the painting and decorative frame	6 hours
Varnish removal	24 hours
Secondary paint removal	31 hours
Retouching, including the addition of filler material	42 hours
Varnishing	2 hours
Stretching the canvas, including preparation	3 hours
Mounting and display treatment	17 hours
Total:	**410 hours**